Lubrication ENGINEERING

February-March, 1947

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CONVENTION ISSUE

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VOL. 3 ★ **NO. 1**

JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS

Let Trabon's Generation of Experience Help Solve Your Lubricating Problems

YEARS AGO when the nucleus of today's Trabon organization was forming, centralized lubrication was in its infancy. Study of these early forms of centralized systems convinced us that the best answer to modern industry's lubrication problem was provided by this type of lubrication.

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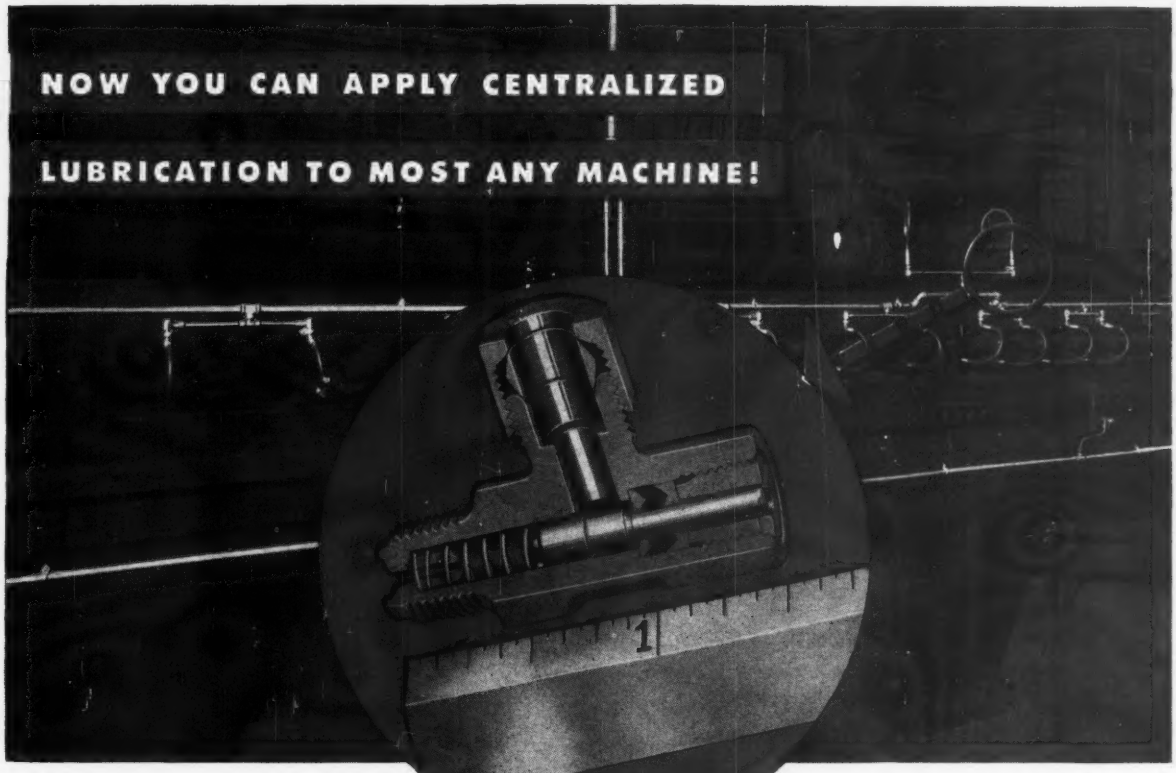

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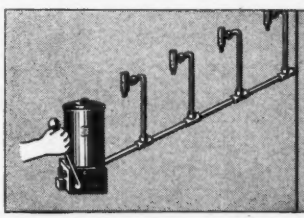

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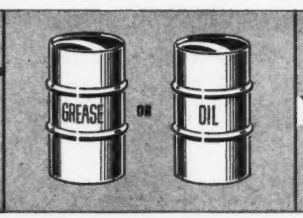

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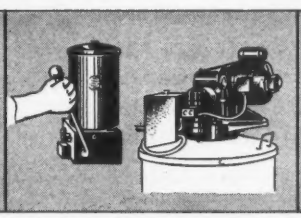

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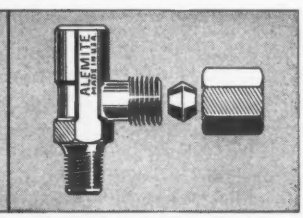

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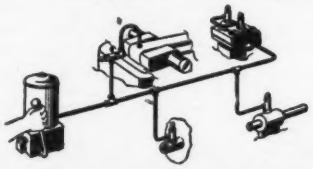

Serves Any Type of Bearing. Installation accessories are available so that the system can be adapted to rotary, oscillating, stationary—plain or anti-friction bearings.

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Farval could have saved this $800 bearing expense

A MID-WEST manufacturer installed forty-one new overhead traveling cranes. All were roller-bearing equipped. Some cranes came from the builder equipped with Farval; others had to be lubricated by hand.

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An overhead crane shutdown can be as serious as a stoppage of any floor-level machinery. Centralized lubrication, therefore, is even more essential on the isolated overhead equipment, which cannot be inspected from the floor and where you may risk serious injury to lubricate the hard-to-get-at bearings.

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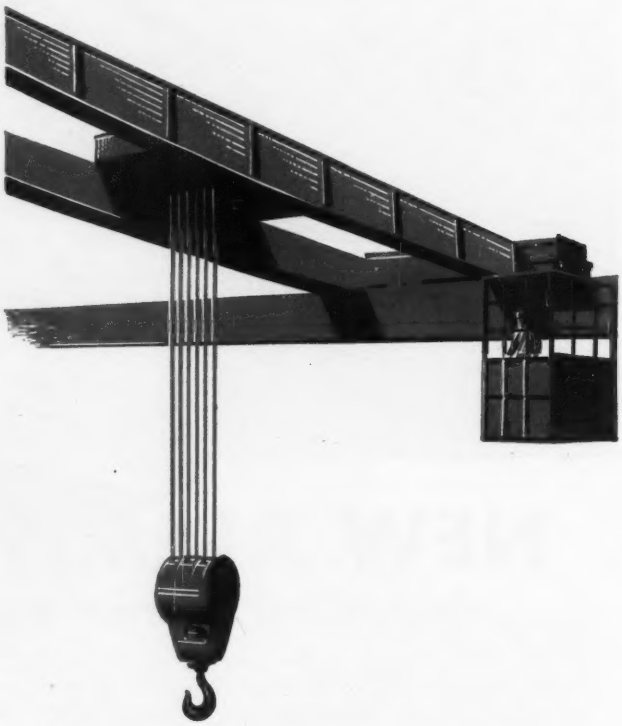


FARVAL—Studies in Centralized Lubrication No. 80

FARVAL
CENTRALIZED SYSTEMS OF LUBRICATION

Editorial

The American Society of Lubrication Engineers is about to enter into the third year of its existence. Those of us who have knowledge of the need for, and faith in, the potential value of a sound technical society devoted exclusively to the broad and varied aspects, both technical and human, of the field of lubrication engineering have little doubt that the Society is destined to grow and to earn a respected position in the professional world.

The degree to which our Society can be of service to its membership and to the world at large will, however, be only in direct proportion to the extent to which each of us, individually and collectively, are prepared to assume the responsibility of actively supporting and promoting the aims and goals of the Society.

There are many worthwhile and pertinent activities in which the Society feels that it should properly assume the leadership. This it cannot do adequately at present because of limited funds and availability of personnel. For example, to mention only a few of the major projects which the Society envisions as properly being within the scope of its activities are the following:

"The provision of a meeting ground through discussion groups of both local and national character where all persons with an interest in lubrication, be they buyers, sellers, equipment designers, maintenance men, or production supervisors, may discuss their common problems."

"The organization of educational programs through close cooperation with schools and universities to train and develop qualified and competent lubrication engineers for service to industry."

"The encouragement of research programs even to the extent of organizing and administering a foundation for lubrication research, the results of which would be made available to the public."

"The provision of a medium for exchange of information in the form of a journal "Lubrication Engineering," and the dissemination of a large amount of existing information which has not yet been adequately summarized and correlated. This can be achieved through the sponsorship of special books, manuals, and by making available translations of foreign books and papers dealing with the broad field of lubrication."

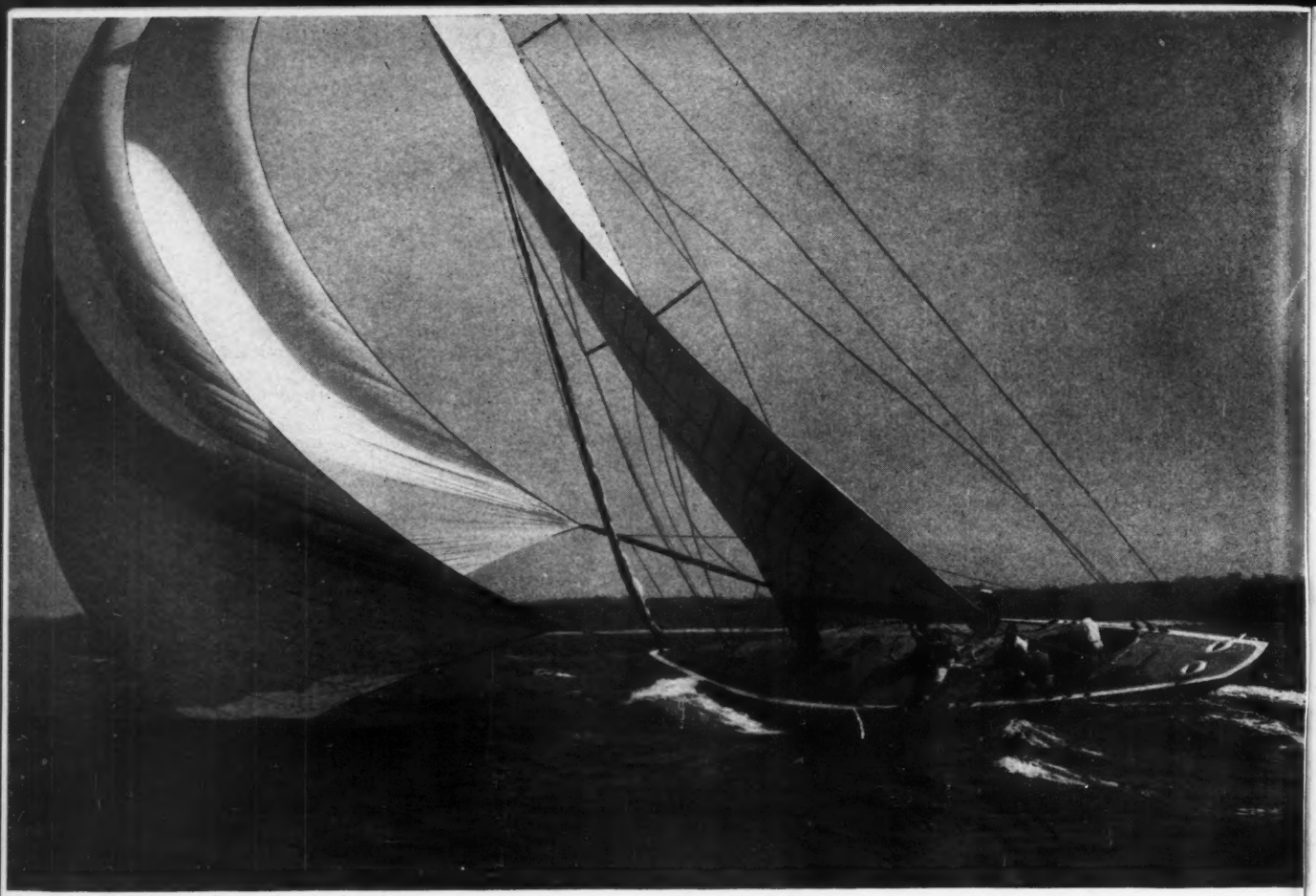
It is becoming more and more apparent to those who are in a position to experience the intimate inter-relationships between sound lubrication principles and all phases of industrial operations that there is a very real and vital need for adequately trained professional lubrication engineers — men who could assume their rightful positions in our industrial economy, with its increasing emphasis upon scientific fundamentals, shoulder to shoulder with the metallurgist, the engineer, the physicist, the mathematician, etc. Men who possess a sound understanding of engineering fundamentals are in exceedingly rare supply. Increasing numbers of young men today are beginning to ask penetrating questions about the profession of lubrication engineering, with particular emphasis upon the nature of the opportunities which may be afforded to outstanding young men in this field. I personally have had many of these questions directed to me, and it has not been easy to admit that the lubrication engineer, particularly those working directly for industries whose interest in lubrication are those of the consumer, has yet to earn a recognized position compatible with the actual merit of his field.

The interest of the Society in sponsoring research into the basic fundamentals of lubrication is likewise a vital one and one which should receive the support of both manufacturers and suppliers of lubricants, and of consumers of their products. There are many fundamental problems in the field of lubrication providing fertile opportunities for outstanding physical-chemical and engineering research which cannot adequately be carried on in any way except through cooperatively supported research. Likewise, a major portion of this type of research, if developed under a cooperative basis, would not injure the legitimate competitive position of an organization, but to the contrary.

The Society has experienced, to date, a healthy and rapid growth, and the prospects for the future are most encouraging. The Society has been particularly fortunate in that unselfish, public spirited, and outstanding men in all phases of industry have rallied to its support. The efforts of these men, however, will be of little avail unless they are warmly and actively supported by each individual member of the Society.

It is my earnest hope that each of you will see fit during the coming year to assume as your personal responsibility the direct contribution to the welfare and value of the Society. This you may do by faithful attendance at the local section meetings and, whenever possible, at the national conventions. You may each individually further contribute in strengthening the Society through your suggestions, advice, and constructive criticisms, all of which are earnestly desired and welcomed. Active participation in the various local and national activities of the Society will not only benefit the Society, but will carry with it a very rich and personal reward in direct proportion to the effort expended. One of the basic truths of life, all too often forgotten, is that we derive the most satisfying rewards from those activities which are designed to serve others

E. M. KIPP.



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Faster and faster hum the machines when Cimcool's on the job. This revolutionary new cutting fluid—a *chemical emulsion* which combines friction reduction and cooling capacity in a degree never before attained—fights heat (the enemy of speed) two ways:

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Design and Lubrication of Bearings*

By R. SCHULTZ

Wadhams Division, Socony Vacuum Oil Co.

THE best made bearings of the finest bearing metals, when viewed under a microscope are rough, and the same condition exists on the surface of a finely finished journal. Put these two surfaces together, loaded to their calculated capacity under rotation or movement and heat develops, sometimes to the extent that one metal will be picked up and welded to the other. This is due to the high local loading caused by the rough surfaces and the actual tearing apart of these surfaces.

For example, we all know that a load imposed on a surface is measured in pounds per square inch. If we reduce the supporting surface of the total load the load per square inch increases. Imagine this in a bearing with microscopically rough surfaces. Conceiveably we might have loads amounting to 100 pounds, not per square inch, but on a pin point. Multiply this several hundred times, add motion, and we have the conditions encountered in a plain bearing. The heat generated by the actual tearing away of the metal will soon cause failure by seizure, in addition to excessive wear and excessive power consumption.

The obvious way to stop this process is to separate these parts to prevent them from coming in contact with one another. This can be done in several ways. One is to introduce a solid seperating medium such as graphite or mica. This will help, although these materials in themselves introduce high and low points. Since, however, they move more readily than metal, and can be replenished, the destruction is not so rapid or complete.

Separation of these metallic surfaces by a fluid film substitutes fluid friction for metallic friction, theoretically saving power and wear. This fluid film can be formed by many liquids, but petroleum oil is the most economical and most readily obtainable; so this discussion will be confined to the use of petroleum oil as a separating or lubricating medium.

Figure 1 represents a journal at rest in a plain cylindrical bearing. Assume that it has been at rest long enough for the oil to have drained completely out of the bearing, as might happen over a weekend. Now let us fill the clearance space with oil and start the journal rotating. It starts to climb up the side of the bearing due to the friction of the two metal surfacses, as in Figure 2. After the first complete revolution there is an oil wet surface and the bearing slips down to the bottom position as in Figure 3. As rotation speed increases, a pumping action starts and the oil is drawn down in the form of a wedge which raises the journal completely off the bearing, as in Figure 4. This continues as long as rotation continues and oil is supplied in sufficient quantity to replace that which leaks out the ends of the bearings. Thus we can replace metallic friction with fluid friction.

This principle can be applied only where an ample and continuous supply of oil is available such as in a circulation system. This type of system includes ring, collar and chain-oiled bearings, pressure and gravity circulation systems, etc. Provision must be made for collecting and returning the oil that leaks out of the ends of the bearings.

There is the other type of condition that, for want of a better descriptive word we shall call "boundary lubrication." This exists where small quantities of oil are supplied intermittently to the bearing, such as by hand oiling, drop, and wick-feed application, etc. Here it is necessary that the oil possess high lubricity or slip as well as high film strength because we do not have the full fluid film to separate the moving members. We must rely on the persistance of film to reduce the drag on the high spots and to increase their area of contact to reduce the unit loading.

Here viscosity plays an important part also. In the full fluid film viscosity was secondary because of the hydraulic action, but here viscosity is depended upon to a large extent to reduce leakage from the end of the bearing, to support the loading and to provide slip. This slip can be and is supplemented by chemical additives which have polar characteristics and actually adhere to the metal.

THE FIVE KEYS TO PROPER BEARING LUBRICATION

1. **See that bearings are properly fitted and as well finished as possible.**
2. **See that there are no grooves in the pressure area and that distribution and auxiliary grooves are properly placed.**
3. **See that the oil is introduced in the low pressure section of the bearing.**
4. **See that the oil is properly supplied.**
5. **See that the right oil is used.**

THE RIGHT OIL IN THE RIGHT PLACE, PROPERLY APPLIED

* *Presented before the Milwaukee Section of the A.S.L.E., October 15, 1945.*

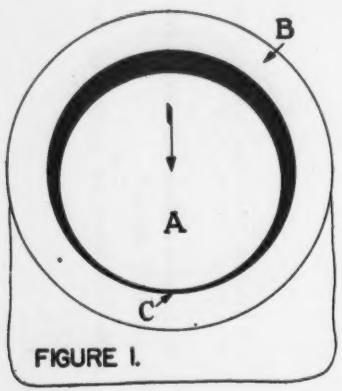


FIGURE 1.

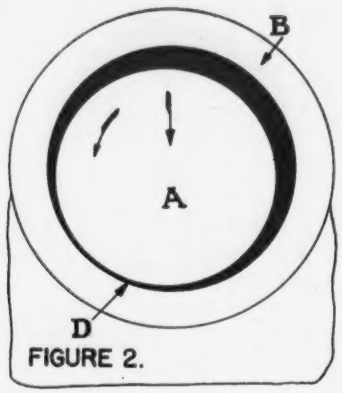


FIGURE 2.

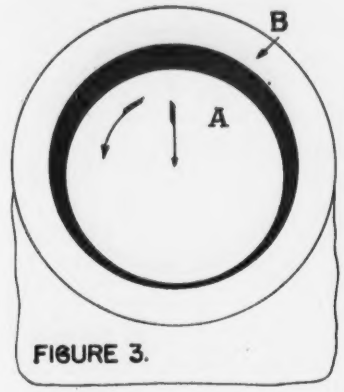


FIGURE 3.

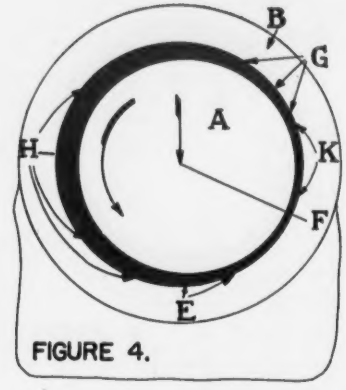


FIGURE 4.

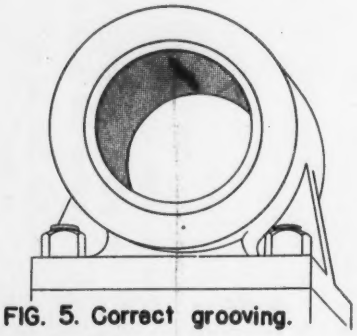


FIG. 5. Correct grooving. Sleeve-type bearing.

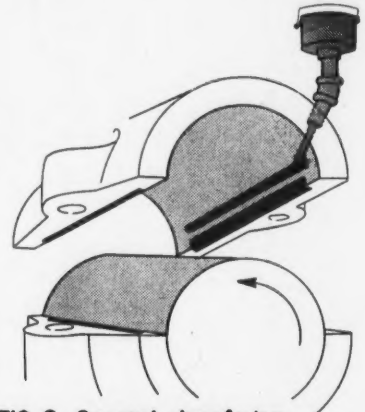


FIG. 6. Correct chamfering - pressure upward.

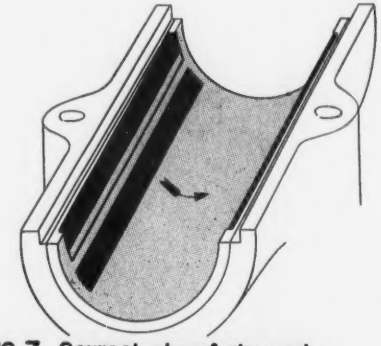
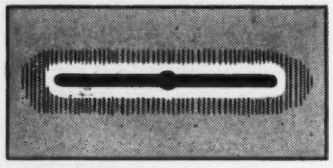


FIG. 7. Correct chamfering and grooving - pressure downward.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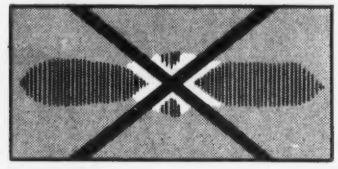
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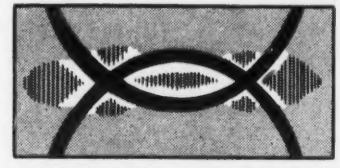
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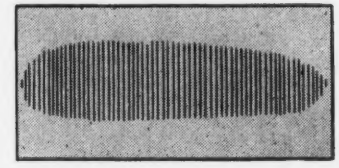
Correct.

FIG. 8. Grooving of pressure area.

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Grooving

There is however another factor which must be considered—the design and grooving of the bearing. As we have just determined, lubricant is drawn into the high pressure area of the bearing by hydraulic or pumping action. This requires that there be no avenue of escape or short circuits to the low pressure area. If such avenues are present, the very principle is destroyed and the bearing is starved and metallic surfaces come in contact, resulting in excessive power consumption and early failure. Incorrectly located grooves in the high pressure area remove part of the bearing surface, thus reducing its ability to carry the load. Such grooves present edges that act as doctor blades or scrapers to remove oil from the surface of the journal, thus eliminating even boundary lubrication. This, then, may be considered an axiom: For successful bearing protection, see that there are no grooves in the pressure area, and that distribution and auxiliary grooves are properly placed. Correct grooving for several types of bearings and loadings is shown in Figures 5, 6, and 7. Correct and incorrect grooving of the pressure area is shown in Fig. 8.

Introduction of Oil

The next consideration is the introduction of the oil into the bearing. Since the pressure on the oil is equal to the weight of the shaft plus the load imposed on the shaft, it does not seem reasonable to try to introduce the oil against this pressure. The oil should enter the bearing at a point where the lowest pressure exists. In cases where the load is downward, we would introduce oil at the top. If the loading fell anywhere in the lower half of the circumference of the bearing top feed would still be correct. Obviously, if the loading is in the top half of the bearing we would be unable to get the oil in unless we used a pump capable of exerting a pressure sufficient to overcome all the loading. This loading in some bearings may be extremely high.

We can overcome this difficulty by changing the point of application. In this case the lowest load is at the bottom, but introducing the oil here is bad because it might never reach the shaft and would leak out rapidly. Under such conditions the oil should be introduced above the diameter, just ahead of the pressure area in the direction of rotation.

Next, we should see that the proper means of applying the oil is employed. This applies to circulation as well as all-loss systems. In the circulation system an ample and uninterrupted supply is necessary. In an all-loss system, the supply should be controllable, reliable and regular. There are many devices for this service, especially designed to function under special conditions. Some of these are drop-feed, wick-feed, bottle oilers of many designs, and force-feed lubricators. The careful selection of these devices is of the utmost importance and they should be carefully studied and their field of service fully understood and appreciated, to avoid the installation of an improper or inadequate device.

Selection of Oil

However, even if a bearing is correctly designed, constructed and installed, and the best method of applying oil is employed, failure may still occur if the proper oil is not used.

The correct oil should be selected either on the basis of re-use, as in a circulating system, or for all-loss operation. If for re-use, the following factors should be considered.

1. Proper body or viscosity for the service encountered.
2. Highest chemical stability.
3. High separating ability, i. e., ability to separate readily from foreign contaminants such as water, dust, dirt, metal particles, and any other foreign matter that may be encountered in the manufacturing process for which the machine is used.
4. Film strength.

For all-loss service, we must consider the following:

1. Proper body or viscosity.
2. High lubricity or slip.
3. Resistance to leakage.
4. Persistence of oil film and resistance to oil film rupture.

Viscosity is the only condition that remains constant in these two classifications. The other factors are important, however, and must be carefully considered.

This basic discussion could be expanded to take into account the thousands of special applications that arise. The most unusual or complicated situation however, is nothing more than a combination of basic facts and conditions. The best method to solve any lubrication problem seems to be to break it down to the basic fundamentals, study and analyze them and then reconstruct to get the solution.

NEW BULLETINS

Industrial Products

"Sun 'Job-Proved' Products for Industry" is the title of a recent publication of the Sun Oil Co., Philadelphia 3, Pa. It lists and describes the most important Sun products for industry and forms a quick and ready reference covering the uses and characteristics of these products.

Cutting Fluids and Coolants

The newest addition to Stuart's illustrated booklet series of technical bulletins, Technical Bulletin No. 5, entitled "Cutting Fluids and Coolants," is a 36-page symposium on cutting fluids as presented at the American Society of Tool Engineers New Era Exposition.

The text consists of four technical papers presented by leading authorities in the cutting fluid field: "What the Tool Engineer Should Know About Cutting Fluids," by W. H. Oldacre, D. A. Stuart Oil Co., Ltd.; "The Testing of Cutting Fluids," by W. J. Wangelin, The Pure Oil Co.; "Cutting Feeds and Speeds," by F. W. Lucht, Carboloy Co., Inc.; and "The Selection of Cutting Fluids," by Joseph Geschelin, Chilton Publications.

Free copies of Technical Bulletin No. 5, and copies of preceding Technical Bulletins are available upon request. Write to D. A. Stuart Oil Co., Ltd., 2729-53 South Troy Street, Chicago 23, Illinois.

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The Third Edition of the DC Silicone Catalog has been announced by Dow Corning Corporation of Midland, Michigan. The several silicones and silicone products and their uses are described in detail. The use of silicones as foam inhibitors, protective coatings, hydraulic fluids, mold release agents and lubricants for extreme temperatures is thoroughly covered.

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A Dilut-O-Graph may be obtained free of charge, by writing to D. A. Stuart Oil Co., 2729-53 S. Troy St., Chicago 23, Ill.

What is a Lubricant?*

By Dr. Henry E. Mahncke

Research Laboratories, Westinghouse Electric Corp., East Pittsburgh, Pa.

Dr. Mahncke here presents some of the physical and chemical phenomena involved in the mechanism of lubrication. Existing ideas concerning viscosity and oiliness are reviewed and the need for more detailed knowledge of these properties is indicated.

Introduction

WE HAVE all heard a great deal concerning lubricants and will continue to hear a great deal more, that being one of the primary functions of the Society. However when we ask bluntly, "What is a lubricant?" we find a situation, which was, I think, best described by the man who said:

> "Myself when young did eagerly frequent
> Doctor and saint and heard great argument
> About it and about and evermore
> Came out by the same door which in I went."

In view of these circumstances I think that some consideration of the topic is justified.

By way of preface, I should perhaps first dispel any hopes you may have of my essaying a definitive answer to the question. My purpose is rather to penetrate the maze of empiricism surrounding the subject, and focus attention on the inherently lubricating qualities of lubricants, incidentally exposing some of our scientific ignorance in the process. This restricts our approach somewhat, but even in this case, to attempt a complete answer would be rather egoistic, since I doubt if one exists, or ever will so long as men are allowed to exercise their curiosity concerning the various riddles propounded by nature.

This trait of curiosity reflects a childhood habit which is quite exasperating at times, as you who are parents well know, of continually asking "Why?" and which unless it is arbitrarily shut off, will never cease. In some adults, that trait has fortunately, or unfortunately as the case may be, led to the development of what are sometimes referred to as "those screwy chemists or physicists," or what you will. Some of you as representatives of that group may resent the implications while others will feel it appropriate. Certainly they were regarded somewhat cynically by the person who stated that the most important purpose of additives in lubricating oil is to keep organic chemists occupied. The term "screwy" is probably applied because of the feeling that most research scientists are cases of arrested mental development in that, while of otherwise normal mentality, they have developed rather than suppressed that habit of asking "Why?"

Now I want to establish a claim to kinship with this peculiar species, since I do not mind being called "one of those screwy chemists." Under any name it is an interesting and enjoyable occupation, though you may note I do not feel impelled to discuss its profitability. So with this in mind, I may safely say, that we could better phrase our inquiry with "Why is a lubricant a lubricant?" without fear of being accused of plagiarizing Gertrude Stein. Essentially we want to answer what by telling why.

Lubricants and Friction

However, we need some point of departure, so we will take "What is a lubricant?" In the broadest sense, a lubricant may be defined as any substance which will reduce the friction between a stationary object and another object in contact with and in motion with respect to it. This immediately gives rise to a further question, "What is friction?" We can say here that by friction, we mean the force required to overcome the resistance of the bodies to the initiation or maintenance of the motion. The existence of this force as a physical entity is easily demonstrated experimentally, as is its variation under the influence of lubricants. Its origins, on the other hand, are still somewhat obscure and offer in themselves a whole subject of discussion and controversy. The scope of this paper is such that we can only indicate briefly some of the viewpoints which have developed as work in the field has progressed.

The early idea was that friction was entirely due to interlocking surface irregularities, and represented the work required to lift the load from one interlocking position to another. This theory has persisted and even today it is recognized that surface irregularities, or finish, play an important part in any frictional phenomena.[1]

* *Presented at the First Spring Meeting of the American Society of Lubrication Engineers, Chicago, Illinois, April 5 & 6, 1946.*

Succeeding theories have tended to give considerable weight to molecular forces existing at the surfaces of bodies in intimate contact, these forces being generally lumped under the term adhesion. However no theory based solely on these forces has ever been able to explain all the observed experimental facts.

More recently considerable evidence has been adduced to show that the bulk properties of the contacting bodies also play some part in determining the nature of frictional forces. At least these properties, such as hardness, melting point, elasticity, crystal structure, etc., can be correlated in some degree with the magnitude of friction. Other more or less extraneous effects such as heat flow patterns, cleanliness, rubbing speeds, and experimental design can likewise leave their imprint on the observed composite force.[2]

Any one of the theories offered to date probably represents an over-simplification of the true state of affairs. One of the most important problems in the field is that of effecting a proper balance between the many chemical and physical factors involved. It is just this point around which a great deal of controversy is currently centered, and it may be expected that the most successful theory to emerge will represent the synthesis of a great many points of view.

In view of this somewhat unsettled situation, it may be more profitable to merely define the relation between lubricants and friction, as we have done, and continue our inquiries along lines in which more concrete facts are available. This is admittedly a somewhat illogical procedure, since the explanation of lubricant effects is inextricably bound up in that of the nature of friction, but it need not constitute an insurmountable obstacle to our approach from some other direction. At this point we have given a formal answer to our question, but to the curious mind it is a very unsatisfactory one. Now we should like to know why lubricants can effect such a decrease in friction.

Perhaps one method of inquiry would be to see what sorts of substances will serve as lubricants. However we then find that so many materials can be and have been used as lubricants that at first sight they seem to have nothing in common. We can point to examples from each of the three states of matter, if you will accept the limitation to three. Bearings in which air or other gas is the lubricant are entirely feasible and useful in some cases, while you are all familiar with the use of graphite and certain other solids. However when we examine the state of the art, we observe that by far the largest volume of lubricants used is in the form of liquids or semi-liquids especially of mineral origin. So for this paper we shall confine our discussion to liquids, in the hope that in answering the question as to why certain liquids are lubricants, we may be able to apply the answers to other forms of matter. In what follows much of our illustrative material will be devoted to petroleum products for the sake of convenience, but the principles discussed will include equally well any substance which might be considered.

In a practical discussion of lubricants, so much is often made of auxiliary characteristics that their primary purpose is lost sight of. We would prefer here to restrict our considerations to those intrinsic properties which characterize a lubricant within the limits of our definition. As we ordinarily know them, these are viscosity and something variously designated as oiliness, lubricity, film strength, or what not, although some of you may question the equivalence of these last terms. Other properties may influence the practical applicability of a particular material in a particular case, but the properties mentioned above determine whether or not the material can even be considered.

Viscosity

Let us examine viscosity first. In a sense, viscosity is really a type of friction itself, since it is a measure of the resistance to an impressed force offered by all liquids, and whose magnitude is expressed in any one of several systems of units such as Saybolt Seconds, Engler or Redwood viscosities, centipoises or centistokes. However, this resistance is quite small compared to the friction of dry surfaces, so that lubrication may be considered to have been effected if the moving body can be separated from the stationary one by a layer of liquid. Hydrodynamic theory shows that this is possible and engineering practice has shown that satisfactory bearings can be designed and operated using fluids of almost any viscosity. A range of 8-1200 centistokes viscosity at 100 F will probably encompass the ones most commonly used, although even these limits may at times be exceeded.

A study of liquids in general shows that even 8 centistokes is a fairly high viscosity, so we are led to inquire as to what sorts of liquids possess the requisite viscosities and why. To do this logically, I think we may engage on a short excursion into the realm of mathematics which should not prove too difficult. You are all familiar with the ASTM charts for indicating the relation between viscosity and temperature. This chart is based on equation (1) shown in Table I.

TABLE 1—VISCOSITY EQUATIONS

(1.)	$\text{Log log } (v+a) = n \log T - C$	Walther[3]
(2.)	$v+a = e^{KTn}$	
(3.)	$v = Ke^{\frac{b}{T-C}}$	Vogel[4]
(4.)	$v = Ke^{\frac{A+Bp}{T}}$	Eyring[5]

Where: v=Kinematic Viscosity
T=Absolute Temperature
p=Pressure
a, b, A, B, C, K, n, are constants.

By a little manipulation, equation (1) may be transformed into equation (2). Equation (3) is another which has been developed to express viscosity-temperature relations, which is generally somewhat more accurate than (1) but more difficult to use. Both these expressions are empirical and as such have no particular relation to the more fundamental properties of matter in which we are interested. However, there does exist another equation (4) which is based on a consideration of the behavior of individual molecules and the action of molecular forces, and we can see some resemblance in the form between it and the other two. There are certain embarrassing dissimilarities also, which need not be dwelt on here, mainly by reason of lack of knowledge as to the reason for their existence. It might be pointed out that this is another of those cases where for the present our search for the why of things is arbitrarily shut off. Further investigations in this direction are needed.

However, some things may still be learned from a study of this expression. The term (A) depends on the size or volume of the molecules concerned. Thus we

can see that the larger the molecule the greater the viscosity. The following figure I serves to indicate how this is borne out. The illustrations are an incorporation of present ideas of the general shape and relative sizes of hydrocarbon molecules.

One notes readily the very considerable increase in going from octane with 8 carbon atoms to octadecane with 18 and dotriacontane with 32. These three are examples of what chemists call paraffins. We use hydrocarbons for illustrative purposes, but is should be emphasized again, particularly in view of recent developments, that these same considerations apply equally well to other liquids.

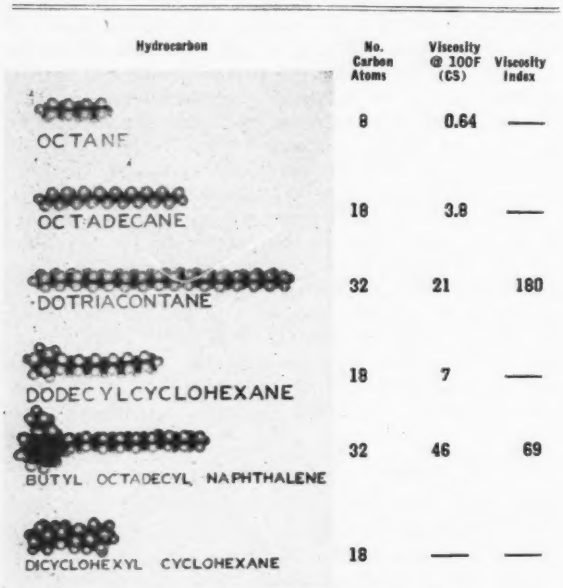


Figure 1. Hydrocarbon viscosity and structure.

There is another factor involved in viscosity which has to do with the shape as well as size of the molecule. In its simplest terms, theory tells us that the quantity (A) depends on the energy or force needed to drag one molecule past another. For example dodecylcyclohexane has the same number of carbon atoms as octadecane, but as the model shows, it has a rather different shape and the process of one molecule getting past or around another one is somewhat more difficult. This difficulty is reflected in the increased viscosity. Similar considerations apply to the case of butyl octadecyl naphthalene as compared with dotriacontane.

I might point out also that while we have designated dodecylcyclohexane as an alkylated naphthene on the basis of ordinary chemical nomenclature, lubricating oil circles might not regard it the same way, since in the naturally occurring materials, what are commonly called paraffins still contain a goodly percentage of the ring structures characteristic of the naphthenes. A true naphthene is represented by the illustration of dicyclohexylcyclohexane. This also contains 18 carbon atoms, but I do not believe any viscosity data are available. I realize that the names of these compounds may not mean very much to some of you, but on the other hand the ability to rattle them off always helps to give a learned air to a dissertation of this sort.

Aside from giving us some idea of the reasons for the relations between molecular structure and viscosity, this expression also gives us some information about the rate at which viscosity changes with temperature. By changing the terms around a bit, we can show that this change is in large part determined by the quantity (A). We have seen how this term affects viscosity. For the same reasons, the more complex or rougher the contours of the molecule, the greater will be the change in viscosity with temperature. Thus the 32 carbon atom dotriacontane has a V. I. of 180, while butyl octadecyl naphthalene has one of only 69.

I should like to digress at this time with some speculations concerning our attitude toward the concept of viscosity index. Up to the present it has served a very useful purpose in educating people to think in terms of viscosity-temperature coefficients and their importance, as related to lubricants. However, it is based on arbitrary standards and must, I think, eventually give way to an index related in some way to more fundamental quantities. Some efforts at replacing it are already under way, and I am of the opinion that these should be actively encouraged.

All of the foregoing considerations apply at constant pressure. However, variations in the external pressure do introduce variations in viscosity which are recognized as being fairly important in lubrication studies. Our theoretical equation gives us some idea of what to expect and why in this regard also. Pressure enters the expression through the term (Bp). Now our theory tells us that the term (B) is also determined roughly by the size of the molecule, and by its shape as it affects the volume. Thus here again viscosities and viscosity-pressure gradients are reflections of molecular characteristics. Unfortunately at present, the determination of viscosity-pressure relations is a rather difficult technique, and data which tend to confirm the correctness of our conclusions are mostly limited to simple compounds outside the range of lubricant viscosities. However, it is known that in many cases a curve of ln viscosity vs. pressure is a straight line as would be expected from the theory. Further, long chain paraffins have lower pressure coefficients than do ring type aromatic compounds. The extended investigation of this aspect of viscosity offers a considerable challenge to both the pure scientist and the lubrication specialist, who each have an interest in this important field.

Thus far we have seen how knowledge concerning the chemical structure of a compound, its molecular weight, etc., correlates with viscosity characteristics. The practical value of such knowledge lies in the ultimate possibility of being able to use it in tailor-making molecules to fit a desired specification. At present, however, one can only point out the possibilities, since while the preceeding discussion has been directed at known and more or less demonstrable facts, one additional and very easily demonstrable fact remains. There is still a great deal we do not yet know.

It should be stressed here, that while we can learn much from a study of viscosity in the light of present theory regarding the fundamental characteristics of matter, our theory does not yet tell us the whole story. The expression we have been considering is not as exact in its reproduction of experimental data as either of the two empirical ones. Beyond this, its best application is found with single molecular species or pure compounds which are a far cry from present day lubricants. While our previous discussion applies qualitatively to mixtures, a quantitative extension of the theory to such a heterogeneous system as even a purified mineral oil is still

desired. Another field about which relatively little is known is that of the effect upon viscosity of varying shear rates and shear stresses. There are some indications that this may be quite important in large molecules of the lubricant type, but theory fails us miserably on this point.

Oiliness

Now having disposed of viscosity, effectively or otherwise, we come to the second property mentioned as characterizing a lubricant, namely oiliness. This is probably the most puzzling of the properties we require in a lubricant, and for that reason, the most interesting.

For purposes of discussion, we will define it as that property of a lubricant which allows a reduction in friction under conditions such that viscosity plays no part. In other words, a truly liquid layer is absent. This is sufficiently broad to cover all the aspects of our subject and yet serves to exclude purely viscous effects as such. There is no doubt that viscous effects are closely connected in many cases with the phenomenon of oiliness, but on the other hand the conclusion that they can account for it completely is hardly a tenable one. This is mentioned particularly in view of the finding that it is possible to explain certain observations in terms of viscosity-pressure gradients which had previously been attributed to oiliness.

If the true liquid layer is absent and we still note a reduction in friction, we are fairly well justified in assuming that some of the lubricant remains. Now we should like to know why and how it is effective, which is just the point that a great many investigators are concerned with. I do not propose to discuss here the different points of view which have grown out of their work since that would take too long. However, certain significant facts have emerged from these studies and from which it is to be hoped that a better understanding of the nature of oiliness may come. The development of more sensitive finger tips to enable an operator to say, "this is a swell or a lousy oil," is emphatically not included in this better understanding.

The important conclusion one notes in reviewing oiliness effects is that most of the available evidence indicates the existence of a very strongly held film of some sort which can resist considerable efforts at dislodging it and thus acts as a shield on the surface of the otherwise contacting parts. Now the question we would like to answer is "Does such a film exist and how does it get that way?"

For a partial answer, we can turn to our molecular models again. Our hydrocarbon looks pretty much the same all over and we can think of the attractive forces of the component atoms as being fairly well balanced inside this structure. However, if we introduce some new kinds of atoms in the molecule, such as oxygen in the model of stearic acid, shown in figure 2, this balance of forces is disturbed, which can very likely result in the existence of some excess force at a particular locality in the molecule. We call such molecules polar and means for demonstrating the existence of these forces are quite well developed. These molecules can then combine in one way or another with other atoms or molecules which are likewise possessed of suitably attractive forces. The atoms in some metallic surfaces, fortunately for the lubrication engineer, constitute a large class of such materials in that they do seem to be able to attract a large variety of surface films, whose

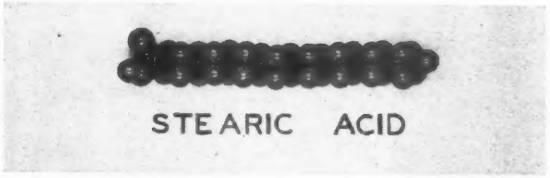


Figure 2. Molecular model of Stearic Acid.

one common property seems to be that they are composed of polar molecules. Variation in the strength and precise type of these forces, ranging from true chemical combination to a very slight adhesion, can account for a considerable portion of the role which the lubricant itself plays in oiliness phenomena.

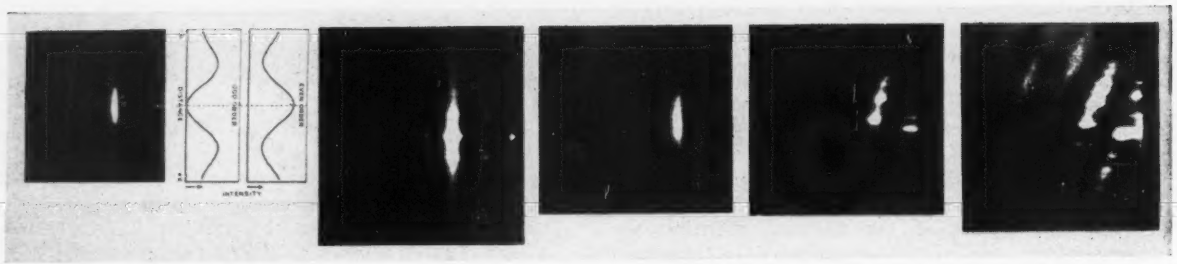
Now this constitutes a somewhat self-consistent theory which can and has received experimental confirmation by a number of methods, essentially involving addition of polar compounds to an appropriate medium and noting whether or not a concomitant reduction in boundary friction occurs. By itself this is at best an indirect method and further corroboration is certainly desirable. Fortunately this is available through methods which are rapidly becoming an important adjunct of lubrication research. I refer to the use of electron and x-ray diffraction techniques in the determination of molecular structure.

By way of illustration, examples are shown of the results of electron diffraction of thin films of stearic acid on metal in figure 3.

These indicate that at the surface of the metal, all the stearic acid molecules in the first layer or first few are arranged in a certain order with their polar ends directed toward the metal and the long tail pointing away from it, perhaps not quite straight, but at a small angle from the vertical. Stearic acid is used here as an illustration, but presumably other molecules act in the same way. One can cite several other instances where this method has been used to show the existence of such ordered films and the presence of the film correlated with frictional properties.

It is in the detailed study of such films that the methods referred to seem destined to advance our understanding of lubrication phenomena. We have not yet arrived at any very complete and satisfactory explanation of oiliness and associated properties, beyond the fact that we have a definite but still rather poorly understood relation between the proven existence of these films and certain frictional characteristics. The lack of a better comprehension of that correlation in terms of molecular and structural properties constitutes at the same time another phase of our scientific ignorance and another challenge to students of the subject. It is to be expected that knowledge gained in this field will also serve to explain the observations made in the closely related fields of corrosion protection, wear prevention, E. P. lubrication, wettability, etc.

It is also pertinent to indicate certain flaws in the knowledge we already possess. The mere possession of polarity is no criterion of oiliness, since available data show no direct relationship between dipole moment and lubricating ability. It does indicate the possibility of film formation, although polarity as measured by dipole moment does not always correlate directly even with the readiness with which films are formed. In this connec-



(a) (b) (c) (d) (e) (f)

Figure 3. Electron diffraction diagrams of stearic acid in single and multi-molecular layers, from Germer and Storks[6].

Left to right above:

(a) Electron diffraction pattern from a single layer of barium stearate molecules on a chromium surface. ($\lambda = 0.07$OA)

(b) Curves representing intensities along the diffuse vertical bands, calculated on the basis of some simplifying assumptions.

(c) Pattern from three layers of barium stearate molecules on a metal surface.

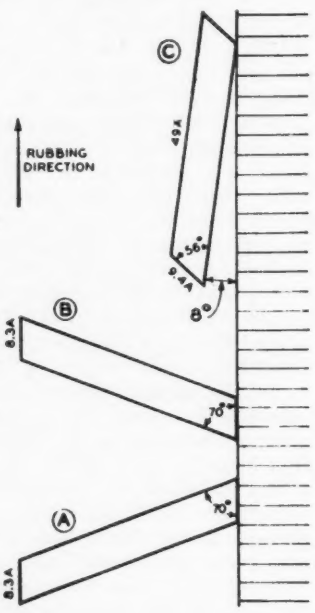
(d) Pattern from a single layer of stearic acid molecules on a metal surface.

(e) Pattern from three layers of stearic acid molecules on a metal surface. Primary beam normal to direction of dipping and dipping direction downward as the pattern is reproduced here.

(f) Pattern from many layers of stearic acid molecules. Dipping direction downward and normal to the primary beam as in preceding illustration.

At right:

Representation of unit cells in stearic acid films, (A) and (B) before rubbing, (C) after light rubbing in the direction of the arrow.



tion, it is perhaps somewhat unfortunate that chemists are prone to use the term polarity somewhat more loosely than is intended by the originally precise definition of the physicist.

Beyond this, the existence of a film of the nature described is also no guarantee of lubricity in the ordinary sense of the word. Once the film is laid down, other characteristics such as chain length and chemical reactivity are apparently very important, as witness the difference between the frictional properties of a film of water and one of stearic acid. Here again what we have done mainly is to bring out the need for further and much greater detailed study of lubricated surfaces.

Thus we have attempted to answer our original question in two ways; first by a formal statement of a phenomenon and secondly by trying to explain how and why the phenomenon occurs. In so doing we are enabled to extend our definition so as to render it a little more comprehensible. That is we can think of a lubricant as a material which effects a decrease in friction by virtue of the possession of the property of viscosity and the ability to form thin protective films of a specific type as regards their composition. A great deal of this discussion can be considered to have little bearing on the practical aspects of lubrication at present, but I am confident that it will have a great deal when we learn to apply the knowledge that is being developed.

Conclusion

One point I should like to make in closing. When we can really think of and explain lubricants in terms of their constituent molecules, we will be well on our way to attaining one of the professed goals of this society. I refer to the transformation of the art of lubrication to a science. To accomplish this objective we must not only consider lubricants alone, but also in relation to their environment and the total behavior of lubricated systems. In so doing we shall be called upon to make use of the techniques and knowledge of the engineer, the physicist, the chemist, the mathematician, the metallurgist, and in fact, nearly all of the special groups which have evolved out of physical science. The ramifications of lubrication extend to all of them and it will be the fusion of effort in this respect that will be the most productive of advances in the science of lubrication. A pure science in that we can demonstrate the relation between cause and effect, and an applied science in which we can logically specify the causes required to produce a desired effect.

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Incipient Seizure and A Few Remarks on Sulfurized Oils

By VICTOR A. RYAN,

Director of Research, Crown Cork and Seal Co., Baltimore, Md.

AS transition becomes more generally known, there seems to be a growing tendency to refer to it as the point of incipient seizure. Such, however, does not appear to fit the case. Incipient seizure is invariably accompanied by a sudden rise, or pop-up, in the torque value, while, in the majority of cases, transition is not. Comparison of Figures 1 and 4 with 2 and 5, respectively, shows that, up to transition and beyond, the torque-increase with applied load is substantially linear and free from the characteristic pop-up of incipience.

There are occasions when transition is accompanied by a torque pop-up which, depending upon circumstances, may or may not indicate incipient seizure. Figures 11 and 12 will serve to further illustrate this point.

The oils of Figures 11 and 12 have identical compositions, being comprised of 50 per cent mineral oil, 48 per cent fatty oil, 1 per cent metallo-organic ester, and 1 per cent sulfur. The sulfur was incorporated by adding 10 per cent of a sulfurized lard oil containing 10 per cent of sulfur. In each of the oils, the type of sulfurized lard oil differed.

In the case of the oil represented by the dotted line, sulfur was added by the "short-time high-temperature" process, which results in reaction by *replacement* of side chain hydrogen atoms with the evolution of hydrogen sulfide and the formation of complex organic vulcanizates. In the "sulfur by replacement" process there is no reduction in unsaturation, as measured by the iodine value, which suggests a possible structure similar to either (a) or (b), Figure 13.

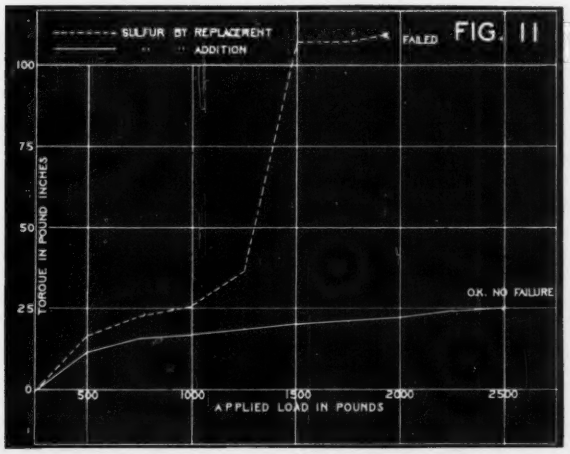
In the case of the oil represented by the solid line, sulfur was added by the "long-time low-temperature" process in which there is no evolution of hydrogen sulfide and in which there is a stoichiometric reduction in unsaturation indicating that reaction is by addition at the double bonds with the formation of cross-bridged vulcanizates of a possible structure similar to either (c) or (d).

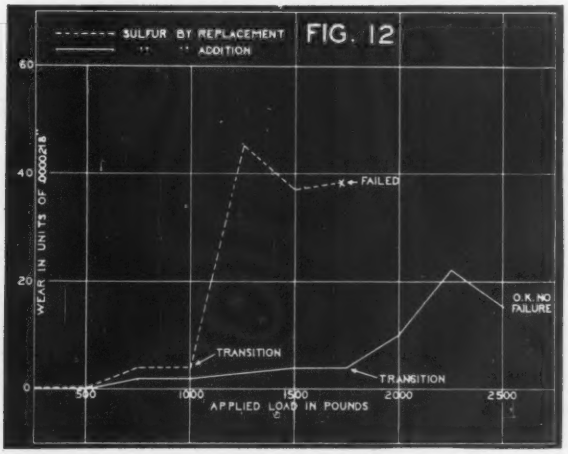
This paper supplements one by the same author published in the September and December, 1946, issues of* LUBRICATION ENGINEERING *entitled "Measurement of Lubricant Film Strength in the Region of Boundary Friction."

The essential difference in the cross-bridging of (a) and (c), and of (b) and (d) is in the relative position of the cross-links in the respective hydrocarbon chains. They have, in the case of "sulfur by addition," removed the double bonds that are contained in and characteristic of "sulfur by replacement." The existence of double bonds in the replacement sulfur molecule appears to offer a reasonable explanation for the torque pop-up and low transition load, as shown in the dotted-line curves of Figures 11 and 12. The solid-line curves show that the saturated addition sulfur molecule has a higher transition load and lower torque characteristics which are uniformly linear and free from pop-up.

The difference in the performance of the respective sulfurized lard oils is primarily due to the thickness of the monomolecular boundary layer immediately attached to the metal. The thickness of this layer is equal to the length of the oriented hydrocarbon chain of the sulfurized oil. In a saturated compound, such as the "sulfur by addition," the normal and oriented hydrocarbon chains are substantially of the same length; but, when an unsaturated compound, such as the "sulfur by replacement," is oriented, it bends double at the double-linkage of the carbon atoms with the result that its oriented hydrocarbon chain is shorter than its normal one by an amount which depends upon the location of the double-linkage in the chain.

Lard oil is represented by the chemical compound *triolein* $(C_{18}H_{33}O_2)_3C_3H_5$ which contains fifty-seven carbon atoms—arranged in three chains of nineteen





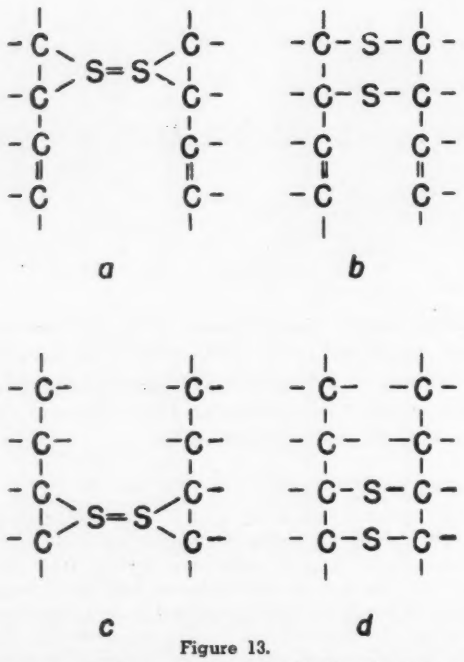


Figure 13.

carbon atoms each—and three double bonds. Saturation of lard oil by hydrogenation removes the double bonds and forms the chemical compound *tristearin* ($C_{18}H_{35}O_2)_3C_3H_5$ which contains the same number and arrangement of carbon atoms as triolein. Even though both compounds have the same number of carbon atoms and the same normal hydrocarbon chain or molecular length, there is a marked difference in the respective lengths of their oriented chains. Millard in his *Physical Chemistry for Colleges*[5] gives oriented triolein a molecular length of 13.0×10^{-8} centimeters and tristearin a length of 25.0×10^{-8} centimeters and attributes the shorter length of triolein to the bending double of the hydrocarbon chain at the double linkage. It is to be seen that the oriented hydrocarbon chain of the unsaturated triolein is 48 per cent shorter than that of the saturated tristearin.

When lard oil is sulfurized by "replacement," the resulting chemical compound $(C_{18}H_{33-2x}S_xO_2)_3C_3H_5$ has the same number and arrangement of carbon atoms and the same number of similarly situated double bonds as triolein; consequently it has the same oriented chain length, namely 13.0×10^{-8} centimeters.

On the other hand, when lard oil is sulfurized by "addition," the double bonds are removed by sulfur cross-bridging and the resulting chemical compound $(C_{18}H_{33}S_xO_2)_3C_3H_5$ has the same number and arrangement of carbon atoms as tristearin and, consequently, the same oriented chain length, namely 25.0×10^{-8} centimeters.

Disregarding specific units of measurement, it can be generally stated that the replacement-sulfur boundary layer is approximately 52 per cent as thick as the addition-sulfur layer. When this fact is coupled with that of Figure 12 which shows that the replacement-sulfur transition is approximately 57 per cent as high as that of the addition-sulfur, it appears that there is some functional relation between the thickness of the boundary layer and the magnitude of the transition load.

In the thinner replacement-sulfur boundary layer, containing "bent double" oriented chains, the reactive sulfur groups are in closer proximity to the metal surfaces than they are in the thicker addition-sulfur layer. Therefore, at relatively lower pressures, the chemically reactive constituents are placed within the sphere of intermolecular forces where they destroy the value of the boundary layer as a lubricant and, by chemical combination with the metal, form a thin film to function as a cutting medium, thus producing transition at a lower value than that of the thicker addition-sulfur layer containing "upright" oriented chains.

The curves of Figure 11 indicate that there must be a marked difference in the nature of the thin chemical films formed at transition which accounts for the dissimilarity in the torque characteristics of the replacement and addition sulfur compounds. In the case of replacement sulfur, there is a definite torque pop-up at transition followed shortly thereafter by failure. The failure was due to a shearing-pin break and the test pieces showed no indication of welding or seizure. The shearing-pin was not strong enough to withstand the high magnitude of torque. Failures of this kind are usually called "torque failures." In this case, transition is accompanied by torque pop-up yet it does not indicate incipient seizure.

The test pieces from this run were decidedly blackened with a sulfide film which proved to be iron sulfide. The metallic sulfide is undoubtedly formed by chemical reaction at transition and has a surface of high energy which accounts for the sudden rise in the torque value. Consequently the torque pop-up is caused by the surface energy of a film and not by incipient seizure.

In the case of addition sulfur, transition is not accompanied by a sudden increase, or pop-up, in torque which would indicate that the chemical film formed at transition has a surface of low energy and, therefore, a chemical constitution different from a metallic sulfide of high surface energy.

The test pieces from this run showed no discoloration and were as bright after the run as they were at the start. No metallic sulfide could be detected on the surfaces. Examination of the oil film removed from the surfaces showed the presence of iron which suggests that the film formed by chemical reaction at transition is a complex iron vulcanizate with a surface energy too low to exert any detrimental effect on frictional characteristics. This case of addition sulfur, as shown by the solid line curves of Figures 11 and 12, is indisputable evidence that transition is not the point of incipient seizure.

The formation of an inorganic sulfide in one case and an organic vulcanizate in the other more or less establishes the fact that the replacement-sulfur compound has a chemical structure different from that of the addition-sulfur compound. There is so little generally known of the cross-bridging of sulfur that it is almost impossible to assign a definite structure to any compound. A possible structure is the best that can be suggested. A study of the possible structures which have been presented leads to the reasonable conclusion that the monosulfide bridge of structures (b) and (d) would most likely give up sulfur to form a metallic sulfide, while the disulfide bridge of structures (a) and (c) would most readily lend itself to the formation of a metallic vulcanizate. This being the case, a structure similar to (b) could be assigned to the replacement-sulfur compound and a structure similar to (c) to the addition-sulfur compound.

Bibliography

[5] *Millard, Physical Chemistry for Colleges,* McGraw-Hill Book Co., New York, 1921.

Silicone Lubricants*

PART II

By T. A. KAUPPI AND W. W. PEDERSEN

Dow Corning Corp., Midland, Michigan

Silicone Lubricating Grease

Most discussions of the properties required in an oil for making a lubricant of grease-like consistency emphasize exactly those properties for which the silicone fluids are outstanding. Some of these properties are:

(a) Low change of viscosity with temperature
(b) Low volatility
(c) Resistance to oxidation
(d) Stability at high temperatures
(e) Low freezing point

When all of the above properties are available in a single fluid, it becomes unnecessary to make compromises in the properties of the final grease, such as sacrificing high-temperature stability for the sake of good performance at low temperatures.

The first silicone material having a grease-like consistency found extensive use as a waterproofing and sealing compound in aircraft ignition systems and as an auxiliary dielectric material in radio systems. This silicone material known as DC 4 Compound is colorless and translucent and can be made in a wide range of consistencies but is usually furnished at a penetrometer of 240-260. It is extremely waterproof and water-repellent and retains its grease-like consistency from –40 F to over 400 F.

DC 4 Compound was tried repeatedly and hopefully as a lubricant for ball bearings, and in every case gave very poor results. Wear was extremely high, bleeding occurred, torque was high, and the bearing life was usually in the order of 24 hours or less. DC 4 Compound, however, did find a type of lubricating use as a surface treatment for ignition cable in wiring up the harness. A similar compound, DC 7, has proved to be very effective as a lubricant for the rubber bags used in low-pressure molding. In these applications, water repellency, oxidation resistance and inertness to synthetic rubber are quite important. Similar grease-like materials are used for lubricating glass and ceramic stopcocks and for pressure lubricated valves. A special silicone grease has also been developed for lubricating joints in systems operated at high vacuums. In these uses, thermal stability and chemical resistance are the most important factors, as the actual lubricating requirements are quite mild.

*Presented before the March 15, 1946, meeting of the New York Section of the A.S.L.E.

Silicone Bearing Lubricants

The problem of making a good silicone grease for bearing lubrication was complicated by two factors. The first was that any thickening agent used should have about the same order of heat stability as the silicone fluids; the second was that most of the metallic soaps proved to be insoluble in the silicone fluids. However, the problem was finally solved by two different methods and at the present time two types of silicone lubricating greases are being made.

One of these two types of silicone lubricating greases, DC 41, is designed for bearings operating at temperatures up to 200 C and at speeds which are relatively low. The other type of silicone lubricating grease is produced in two formulations, DC 33 and DC 44. DC 33 is designed for high speed bearings operating at very low temperatures but it also has good lubricating life at elevated temperatures. DC 44 is designed for bearings operating at elevated temperatures and at speeds up to 20,000 rpm. An indication of the low volatility of these silicone greases is contained in Table II.

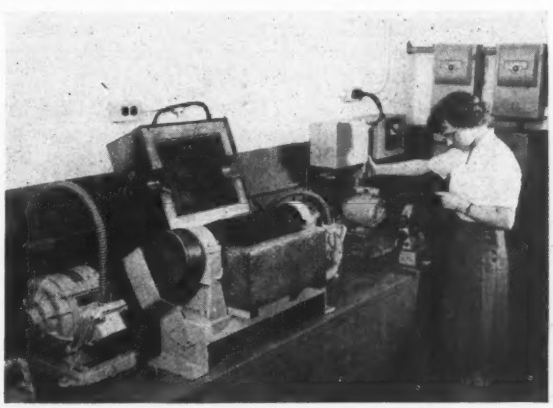


Figure 7. In the test device shown at center, six No. 212 ball bearings are mounted on a shaft, and spring-loaded with 150 pounds radial load. Shaft and bearings are enclosed in an oven which may be heated electrically to any desired temperature. The shaft is rotated at 1750 R.P.M. Laboratory technician is checking coasting time on single bearing tester. In this set a No. 212 bearing with bronze retainer ring is operated in an electrically heated cast iron housing. Shaft is rotated at 1750 R.P.M.

TABLE II—PERCENTAGE OF WEIGHT LOST AFTER 40 HOURS AT 175C (347F)*

High Temperature Petroleum Greases			Dow Corning Silicone Greases		
A	B	C	DC 33	DC 41	DC 44
58.3%	39.3%	34.8%	4.6%	4.2%	3.3%

*After 40 hours exposure at 175C, a crust had formed over the surface of the three petroleum greases. The silicone greases were still soft and serviceable.

These three silicone greases are manufactured to conform to the specifications set forth in Table III. The properties of these three silicone greases will be discussed in greater detail in the following pages, and the results of some of the tests conducted to determine their lubricating life will be described.

TABLE III—SPECIFICATIONS FOR DOW CORNING SILICONE GREASES

Test	DC 33	DC 41	DC 44
Worked Penetrometer (ASTM-D 217-44T)	280-330	295-305	240-260
Flash Point (ASTM-D 92-33)	525F	535F	550F
Dropping Point (ASTM-D 566-42)	390F	390F	390F
Not less than	200C	200C	200C
Bleeding (ANG-3A Specification) 16 hrs. at 110C—less than	2%	4%	2%

Silicone Grease DC 41

In this silicone grease, a very finely divided carbon black is used as the thickening agent for a silicone fluid of good lubricity. It was the first which showed promise in the lubrication of ball bearings. In one series of tests, six No. 212 ball bearings were mounted on a shaft in an enclosure which could be heated to any desired temperature. This testing device is shown with the oven lid open in Figure 7. Each bearing was spring-loaded with 150 lbs. radial load, and the shaft rotated at 1750 rpm by a 1 hp motor. Failure of the bearings was determined by several methods.

(1) Decrease in the time required for the rotating shaft to coast to a stop when the motor is shut off.

(2) Observation of any abnormal temperature rise of an individual bearing by means of a thermocouple placed in each bearing housing.

(3) Observation of any sudden increase in power required to drive the test set as indicated on a watt meter.

These three indications of bearing failure have, in general, appeared simultaneously and seem to coincide with the first appearance of unusual noise from the test set.

This test set was first used to evaluate the life of DC 41 grease at 150 C (302 F) and an average bearing life of about 1300 hours was established. At 125 C (257 F) the bearing life was 6000 hours. These figures are about eight times the values that were observed with the best petroleum greases.

However, when these results were checked on the bearings of electric motors, it was found that the results were much less favorable. The principal difference between the two test methods, it was found, was that in the six-bearing tester described above, the ball bearings had bronze retainer rings and in the electric motors the bearings had steel retainers. The laboratory test set could be run until an actual grease failure was indicated by hardening of the grease, while in the bearings with steel retainers the failures were due to wear or breakage of the retainers.

The conclusion to be drawn from this test is that DC 41 is a relatively poor lubricant for hardened steel balls against a soft steel retainer. This agrees well with wear-testing results described previously on silicone fluids. Despite this behavior, however, DC 41 has been used in bearings with steel retainers with considerable success, especially in high-temperature applications. It will function as a grease at temperatures of 200 C and above, and in some specialized applications, such as in the pumping of very hot liquids or in bearings which must be located in high-temperature ovens, DC 41 has definite value. If bearings with bronze retainers can be obtained they will give several times the life obtainable with ordinary bearings.

Silicone Grease DC 44

Several tests made in high-speed bearings with DC 41 showed that it was not at all satisfactory. At 10,000 rpm and 150 C it failed within 24 hours, and in addition produced excessive friction and temperature rise in the bearing. Testing of various grease compositions eventually resulted in DC 44, which is a silicone fluid thickened with heat stable metallic soaps. DC 44 has now been tested quite extensively at both 1750 and 10,000 rpm and at bearing temperatures between 115 C (239 F) and 200 C (392 F). The tests have been of three distinct kinds, as described below.

I. *Single-Bearing 1750 rpm Tester*

In this test a No. 212 bearing with a bronze retainer ring is operated in an electrically heated cast iron housing (see Figure 7). Grease failure is determined by measuring both hot and cold coasting times and by observation of the appearance of the grease at intervals. As is shown in Table IV, grease failure occurred after 2600 hours at 150 C, or after 450 hours at 200 C. Tests at lower temperatures are now being conducted, but it obviously will take many months to reach a definite result.

TABLE IV—LIFE TEST ON DC 44 GREASE

Bearing Temperature °C	°F	Test Method and Lubrication Life in Hours: I. 1750 rpm Tester	II. 1750 rpm Electric Motor	III. 10,000 rpm Tester
115	239	....	>3500	....
125	257	....	>2500	>2800
150	302	2600	....	2200
200	392	450	....	....

II. *Bearings in 1750 rpm Electric Motors*

Grease tests are relatively easy to run in laboratory bearing test sets, but it is always debatable whether the results will compare with those obtained in actual use. Bearing loadings, vibration conditions and other mechanical factors are hard to duplicate in the laboratory and actual thermal gradients inside the bearing of an electric motor are quite different from those produced in laboratory tests. In the normal type of induction motor, operated at high temperature, the heat flow is outward through the motor shaft, and the outer race of the bearing therefore is cooler than the inner race. In a laboratory bearing, such as described in I, the temperature gradients are reversed, in that the heat flows from the hot housing through the bearing to a cooler shaft. The inner race, then, is cooler than the outer race. In the case of a test bearing operated in an oven, the thermal gradients will be quite small with only the small amount of heat generated in the bearing flowing out through both the inner and outer race.

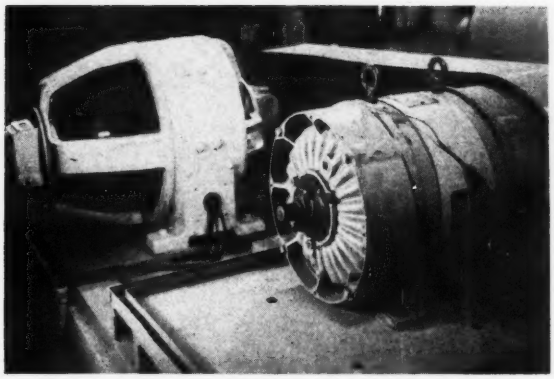


Figure 8. Silicone insulated 7½ H.P., 1750 R.P.M., 440 volt induction motor is belt connected to a generator and loaded so that bearings operate at temperatures up to 150C. in testing silicone greases.

The above considerations led to tests of DC 44 in electric motors. Bearing temperatures are produced by actually loading the motor to the desired extent with a belt-driven generator. This test set-up is shown in Figure 8. The motors used are 7½ hp, 1750 rpm, 440 volt induction motors, and they are insulated with silicone varnishes to permit operation of the bearings at temperatures up to 150 C. Motor winding temperatures may go as high at 275 C.

Column II in Table IV shows that the two tests, at 115 C and 125 C are still in operation after 3500 and 2500 hours. Motor coasting times, which are taken with the bearings both hot and cold, and the bearing temperature rise obtained with the motor operating under no load, indicate that little if any change has occurred in the bearings or in the DC 44 Grease.

III. 10,000 rpm Tester

This tester is shown in Figure 9 and consists of two standard No. 204 bearings mounted in cast iron blocks which are electrically heated. The bearings support a shaft which is belt-driven at 10,000 rpm. Changes in torque are measured by temperature rise of the bearings and changes in hot or cold coasting time are used as indications of bearing failure. As shown in Table IV, failure was obtained after 2200 hours at 150 C, while another bearing was still operating after 2800 hours at 125 C. Several high temperature petroleum greases have been tried in this tester and failure has occurred in the range of 50 to 200 hours.

These results indicate that DC 44 has about ten times the life of a good petroleum grease at high temperature and high speed. This agrees quite well with the results shown in Column I of Table IV, and indicates that in bearings with steel retainers DC 44 has as long a service life as it has in bronze retainers.

During the operation of the 10,000 rpm tester with DC 44, the bearing temperature on two separate occasions was inadvertently allowed to go above 200 C. In one case, it went to 225 C for one hour, and in the other to 240 C for 15 minutes. This occurred in about the middle of the test run, and did not seem to affect the grease appreciably. It is likely, however, that the grease life was considerably shortened by these extreme temperatures, and it would be surprising if the metals in the bearings were not harmed by this treatment.

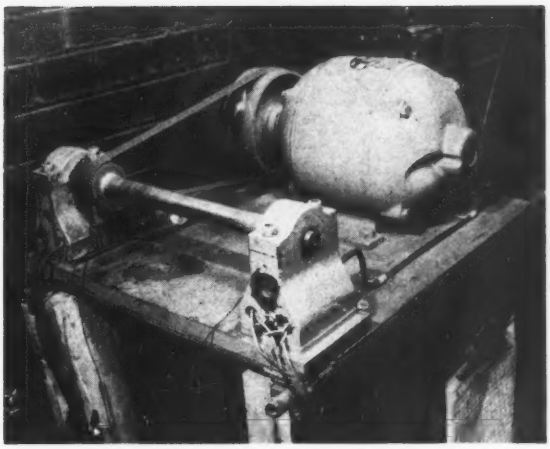


Figure 9. Grease testing device consists of two standard No. 204 bearings mounted in electrically heated cast iron blocks. The bearings support a shaft, belt driven at 10,000 R.P.M. Changes in torque are measured by temperature rise of the bearings and changes in hot and cold coasting time are used as indications of bearing failure.

Silicone Grease DC 33

In the first portion of this paper, it was pointed out that if all the desirable properties are obtainable in one fluid, it becomes unnecessary to make special greases for different operating conditions. However, even with silicone fluids as grease vehicles, it has not yet been possible to make a grease that has the extreme high temperature performance of DC 44 and an extremely low freezing point. DC 44 will operate well at a temperature of −40 F, but begins to get stiffer at −50 F. Some applications, mostly military, require performance at even lower temperatures, and this can be obtained with DC 33.

DC 33 is a soap-type grease similar to DC 44, but begins to get stiff at temperatures in the order of −70 to −80 F. Bearing tests have shown that its life at high temperature is about half that of DC 44, so that it is still four to five times as heat-stable as the best organic high temperature greases.

Conclusion

The test results described above show that silicone fluids offer possible solutions to lubrication problems involving heat stability, oxidation resistance, non-volatility and low change of viscosity with change in temperature.

Silicone lubricating greases can be used to obtain operation of ball bearings at temperatures far above those considered practical with petroleum greases. In addition, a silicone lubricating grease can be made with excellent low temperature behavior and with high temperature stability considerably better than that of the most stable petroleum greases.

The greatest significance of the test results, however, is that DC 44 offers the possibility of a completely stable grease for the permanent lubrication of ball bearings. Lack of bleeding, extremely low volatility, and absence of gumming tendencies even at elevated temperatures, indicate its suitability as the lubricant for bearings which must operate for years without attention or relubrication.

(*Continued on page* 22)

PROGRAM

Second Sprin

The American Society of

MONDAY TUESDAY & WEDNESD

WILLIAM PENN HOTEL

MONDAY, MARCH 17, 1947

9:00 A.M. REGISTRATION — 17th Floor, William Penn Hotel.

10:00 A.M. BUSINESS MEETING OF OFFICERS AND DIRECTORS OF THE SOCIETY. Parlor D, 17th Floor.

2:15 P.M. FIRST TECHNICAL SESSION — Urban Room

Chairman — N. C. Penfold, Chairman A.S.L.E. Program Committee.

Welcome to Pittsburgh by The Honorable David L. Lawrence, Mayor of the City of Pittsburgh.

"President's Message" — Dr. E. M. Kipp, President of A.S.L.E.

"The Use of Extreme Pressure in the Study of Lubricating Oils" — Dr. T. C. Poulter, Armour Research Foundation, Chicago, Illinois.

"The Friction of Dry and Lubricated Surfaces as Determined by the Stick-Slip Method" — Drs. Morgan, Muskat and Reed, Gulf Research and Development Company, Pittsburgh, Pennsylvania.

"Lubrication of Industrial Gear Drives" — Mr. F. Richardz, Westinghouse Electric Corp. Gearing Div., Pittsburgh, Pennsylvania.

9:00 P.M. SMOKER — Cardinal Room.

The Pittsburgh Section cordially invites the members of A.S.L.E. and visitors in attendance at the convention to be its guests at the smoker. Entertainment, featuring the Westinghouse Quartette, smokes and refreshments.

TUESDAY, MAR

9:45 A.M. SECOND TECHNICA

Chairman — F. C. Lempert, burgh Section.

"Hardy Coefficient Measurements Porpoise Jaw Instrument Oil" matic Electric Company, Chicag

"Synthetic Lubricants for Aircraf Erck, Bendix Aviation Corpora

"Ring Lubrication of Journal Be Dutch Shell, Delft.

Report of the Nominating Comm

12:30 P.M. LUNCHEON — Cardina

2:15 P.M. THIRD TECHNICAL

Chairman — D. F. Hollingswor A.S.L.E.

"The Physical and Chemical Mech Oils"—Drs. Eugene Lieber and H cal Corporation, Chicago, Illinois

"Oil Flow and Running Tempe Bearings" — Mr. John Boyd, W tories, Pittsburgh, Pennsylvania.

"Design of Steam Turbine Bearings Electric Company, Schenectady,

"Aluminum Alloy Bearings" — Mr. Company of America, New Kensi

7:00 P.M. ANNUAL BANQUET —

Toastmaster: G. L. Sumner.
Speaker: Dr. E. R. Weidlein, Di Industrial Research.

Introduction of New Officers.

(Dress Informa

This program has been carefully planned to be of utmost va highly complex industrial machinery. The American Soci Pittsburgh Convention Committee extend a cordial welco and social functions listed above.
A nominal registration fee of $2.00 will be charged non-me of guests who make application for membership in the Soci

PROGRAM

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y of Lubrication Engineers

ONESDAY MARCH 17, 18, 19, 1947

OTEL, PITTSBURGH, PA.

Y, MARCH 18, 1947

ECHNICAL SESSION — Urban Room.

Lempert, Convention Committee, Pitts-

asurements on Improved Substitutes for ment Oil" — Dr. S. Bloomenthal, Auto- any, Chicago.

or Aircraft Instruments" — Mr. E. H. on Corporation, Teeterboro, New Jersey.

Journal Bearings"—Mr. H. Blok, Royal

ating Committee and Election of Directors.

— Cardinal Room.

CHNICAL SESSION — Urban Room.

Hollingsworth, Regional Vice President

mical Mechanism of Engine Preservative ieber and Helen Sellei, Nox-Rust Chemi- ago, Illinois.

ng Temperatures of Lightly Loaded n Boyd, Westinghouse Research Labora- nnsylvania.

ne Bearings" — Mr. Frank Linn, General chenectady, New York.

ngs" — Mr. H. Y. Hunsicker, Aluminum , New Kensington, Pennsylvania.

ANQUET — Ball Room.

Sumner.

Weidlein, Director of Mellon Institute of

Officers.

ress Informal).

WEDNESDAY, MARCH 19, 1947

9:45 A.M. FOURTH TECHNICAL SESSION — Urban Room.

Symposium on *"Scientific Lubrication as a Profit Factor."*

Chairman: W. F. Leonard, Regional Vice President A.S.L.E.

"The Justification of Lubrication Engineering to Management" — Mr. C. L. Pope, Eastman Kodak Company, Rochester, New York.

"Latest Trends in Machine Tool Lubrication" — Mr. James Keen, Gisholt Machine Company, Madison, Wisconsin.

Discussion Leaders: —

Mr. C. S. Bullions, Socony-Vacuum Oil Co.

Mr. C. E. Pritchard, Republic Steel Corp.

12:30 LUNCHEON — Forum Room.

1:45 P.M. BUSINESS MEETING OF OFFICERS AND DIRECTORS OF A.S.L.E.

1:45 P.M. PLANT TOURS —

ALUMINUM COMPANY OF AMERICA

CARNEGIE ILLINOIS STEEL CORPORATION

WESTINGHOUSE ELECTRIC CORPORATION

(Arrangements for trips to any of the above plants should be made at the Registration Desk before 5 p.m. on Monday.)

tmost value to men who design, operate and maintain today's ican Society of Lubrication Engineers, its officers, and the ial welcome to all those interested to attend the technical

d non-members. This amount may be credited toward dues the Society within 30 days of the convention.

Silicone Lubricants

(*Continued from page* 19)

Discussion

Discussion, read by Mr. C. R. Gillette, New Departure Division, General Motors Corp.

I must admit frankly at the outset that my own experience to date is not sufficiently complete to either be enthusiastic about the so-called synthetic lubricants or to be critical of them. However, I have attempted to set down our reaction to the use of such products and in particular to indicate the factors which must be considered in developing them into suitable ball bearing lubricants.

Prior to the war, ball bearing applications involving extremes of temperature were, with a few exceptions, more or less uncommon. This may have been due in part to the fact that suitable lubricants were not available and designs were therefore modified so as to keep temperatures in the normal range. During the war, however, applications were evolved where temperature extremes were inherent and lubricants had to be provided to handle them. In many instances both low starting and high operating temperatures were present in the same application. Early in the war the AN-G-3 type greases were developed which were reasonably successful for control pulley and airframe bearings, but they were inferior, in life at high temperatures, to the normal ball bearing greases. This can be attributed mainly to hardening of the grease by evaporation and oxidation. These properties, among others, made them of limited value for many motor-driven applications.

A similar, related, problem also existed in the lubrication of aircraft instrument bearings, where extremely low viscosity oils were required to provide a minimum resistance to rotation. These oils also required a high degree of lubricity, particularly for gyro bearings, and good corrosion preventive characteristics. A product meeting these requirements was produced under Specification AN-0-4. However, in some applications this product did not give the desired life—again due to the evaporation of the low viscosity petroleum oil component.

In addition to these low-temperature applications it became evident that a need existed for a strictly high-temperature grease, particularly in connection with the proposal to increase operating temperatures of electric motors to 300 F or higher. The existing normal ball bearing greases were found in general to be too short lived, particularly because of their oxidation rate, to adequately answer the problem. Development work on this project is still in progress.

These examples are cited because they produce a definite pattern and indicate some of the modifications necessary to develop improved lubricants. In all cases the requirements show a need for greater resistance to oxidation, less evaporation and, if a wide temperature range is to be covered with the same lubricant, a minimum change in viscosity or consistency with temperature.

In an effort to meet these requirements two types of so-called "synthetic lubricants" have been made available. The first are the organic esters which have been used both as fluid lubricants and also incorporated into greases. The fluid lubricant has been used successfully in aircraft instruments, although originally the esters were found to have little, if any, rust protection value. This characteristic was corrected, with no apparent deleterious effects, by incorporating a corrosion inhibitor in the ester. The ester greases appear to have inherent rust protection characteristics not present in the esters themselves. It may be interesting to note in passing that greases of this type appear to have exceptional lubricity and prevent, or retard, so-called "false brinelling" or "vibration brinelling" to a greater extent than other existing lubricants.

The second of the "synthetic lubricants" which have been proposed are the silicones which Mr. Kauppi has described so thoroughly in his paper. These products also are characterized by a high degree of stability, a minimum evaporation rate and low viscosity temperature change. There are indications, however, that the silicone lubricants may not have as high a degree of oiliness as would be desired although, to be perfectly fair, I must admit that our test work on these products has been held up and our data are incomplete.

It should be realized that, while inadequate resistance to oxidation is one of the main faults of existing petroleum greases, the use of materials having superior oxidation characteristics does not necessarily insure a good ball bearing lubricant. It must also be appreciated that as ball bearing manufacturers we are mainly concerned with greases for permanently lubricated sealed bearings. The sealed bearing which we introduced in 1927 has found an ever increasing demand and has jumped from a production of 13,000 bearings in the year of 1928 to over a million bearings per month in 1943. I am sure that a careful analysis would show that this trend to sealed bearings ties in with the improvement in ball bearing lubricants which has taken place over the years and which has permitted the expanded use of sealed-in lubrication. Further extension of the use of sealed bearings is dependent mainly upon the development of lubricants giving longer life, which of course is simply another way of saying "greater stability and resistance to oxidation." However, in addition to the increased stability, there are many other characteristics which a sealed bearing lubricant must possess:

1. Leakage of grease past the bearing seals must be reduced to a minimum. This is important not only to conserve the supply of lubricant in the bearing, but also to prevent damage to adjacent equipment such as the commutator and the winding of electric motors, or to the material being processed, such as the yarn or fabric in textile equipment. Leakage is due to a variety of causes, such as: aeration which results in expansion of the grease volume; separation of oil and soap with a subsequent leakage of oil; decrease in consistency due to the severe beating action in the bearing; and the presence or formation of fibrous structures which do not channel and therefore develop pressure within the bearing.

2. The torque caused by the lubricant must be kept to a minimum, not only because a high torque defeats the purpose of an anti-friction bearing, but also because the torque is directly related to heat development which is disastrous, particularly in high-speed applications. The normal effect is to cause distortion of the casting which throws the bearings out of alignment and results in failure of the ball retainers.

3. The grease must have adequate lubricity. In the absence of abrasives, no measurable wear should occur during the rated life of the bearing. This condition is met with conventional petroleum greases, except under conditions of severe misalignment or vibration, in which cases the pressure between the balls and retainer exceeds the load-carrying ability of petroleum lubricants.

4. The same lubricant must be suitable for the majority of applications involving extremes of both speed and temperature. Not many years ago this view was considered to be highly idealistic and thoroughly impractical. Today we have, in a single lubricant, a product which has been used with entire satisfaction in equipment which must start at -40 F; in applications having operating temperatures as high as 250 F, although it is admitted that use at this temperature is limited to those applications where a comparatively short life can be tolerated, and the high-speed spindles operating from 12,000 to 20,000 rpm.

5. Another incidental factor, but one which must be considered, is the effect of the lubricant upon the seal material.

6. In addition the lubricant must possess positive anti-corrosion characteristics, particularly against condensation.

From the standpoint of the bearing manufacturer it is inefficient and impractical to grease bearings with a wide variety of special lubricants. It is conceivable that it may be some time before a product is developed which will be adequate for both extremes of temperature and that in the interim the problem will resolve itself into the use of three lubricants: (1) an improved product for the majority of applications which operate between –40 F and 175-200 F. Probably at least 95% of our production operates in this temperature range. (2) A product for temperatures below -40 F and (3) a product for applications operating over 200 F. However, it must be recognized that some difficulties will still exist in applications where the temperature ranges overlap.

It is possible that further improvement in ball bearing lubricants can only be met with some type of lubricant other than petroleum. The progress in the synthetic lubricants to date is definitely encouraging and further development holds promise of important contributions to the field of lubrication.

Statement of Policy of the A.S.L.E.
With Regard to the Promulgation and Development of Purchase Specifications and Performance Standards for Lubricant Products

Many questions have been asked the officers as to what represented a policy of the Society.

Certainly, the major objectives are concerned with serving, in the best way possible, the needs of the members of the Society, the needs of industry, and the dissemination and development of scientific knowledge related to the field. Cooperation between all groups—users, suppliers, manufacturers, and individual members—must be encouraged.

To give some idea of a definite viewpoint, the following promulgation was recently released by Dr. E. M. Kipp, President of the Society.

"The officers and Board of Directors of the American Society of Lubrication Engineers, believing that our Society is in a unique position by the nature of its membership to acquire field data, hereby offers its service to Committee Z-11 of the American Standards Association through close correlation with other Societies such as the ASTM, API, NLGI, CRC, or any other kindred Society you may designate, in sponsoring test procedures such as are being worked out in the ASTM. It is not to be construed that our Society intends to assume the functions and responsibility of developing and setting up standards either in the testing of lubricants or in the development of procurement specifications. Rather, we feel that by working with and through groups such as the ASTM, the field experience of our members in the use of test methods would be beneficial and that our group could assist in the application of the test methods adopted as standards."

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LIQUID CONTROL SPECIALISTS SINCE 1885

A Synthetic Lubricant for Hydraulic Fluid*

By EDWARD G. EGAN

Celanese Chemical Corporation

Because of its inherent inability to support combustion, tricresyl phosphate finds use as a hydraulic fluid. Other properties contribute to its usefulness in this application.

In addition, several valuable physical and chemical properties which indicate advantages as an additive for lubricants are detailed.

IT WAS not until some years after World War I that the chemical industry showed the results of the tremendous surge toward chemical synthesis; however, early efforts during the first war did produce a compound, tricresyl phosphate, which today serves as an ideal synthetic hydraulic fluid and oil additive by virtue of its unique physical and chemical properties. The history of tricresyl phosphate in its earlier days reminds one of a ship plowing the rolling sea. For awhile it rode the crest of the wave and then perilously dipped into the trough. Let us briefly run through the stormy past.

During World War I when the Japs held a corner on camphor and very politely extracted a handsome price from their eastern ally, our chemists knuckled down to the task of untying one of the bonds that held the American chemical industry in feudal subservience to foreign producers. It was decided to find not only as good a plastcizer but one that would render Celluloid non-flammable and odorless. It is not surprising then that a phosphate compound should lead to the choice of substitutes since the phosphate radical has the inherent property of not supporting combustion. This desire back in 1919 to not only overcome the high cost of Japanese camphor but to reduce flammability of the finished product resulted in unexpected dividends years later, as we shall see.

Production of tricresyl phosphate for the first time in history on a commercial scale in 1919 came about through the guidance of a Mr. W. L. Lindsey (hence our trade name Lindol) and saved the day for Celluloid.

However, with the return of low priced camphor and the subsequent American synthetic production, Celanese had an idle capacity for tricresyl phosphate and for a time the picture looked gloomy. The magic of chemistry, however, soon brought forth an entire new industry coping with the assembly line technique for automobile production in the twenties. Spraying was introduced using low viscosity pyroxylin lacquers. As an odorless non-flammable plasticizer, Lindol was on its way once again and production proceeded at capacity.

Along with the progress in volume technique for making the automobile, improvements were advanced in engine and mechanism design. Automotive engineers introduced high compression motors, hypoid gear differentials, free wheeling and automatic shifts; presenting new problems for lubricating engineers. Now, this was good news for Lindol since it was subsequently replaced as the plasticizer in pyroxylin lacquers by the newer synthetic alkyl resins resulting in another nose dive into the doldrums of productive inactivity. It was good news because research had heralded the compound, tricresyl phosphate, into the awe inspiring tonnage requirements of the petroleum industry. But, in the scramble to find the elixir of oil additives, chemists tested hundreds of complicated compounds passing over tricresyl phospate and leaving it to a minor appointed place in certain extreme pressure lubricants. By this time, however, Lindol earned a permanent place in the protective coatings field as a preferred plasticizer; so that the temporary, shall I say, distinterest in tricresyl phosphate among petroleum chemists did not again send our productive efforts into a tailspin.

The next and last chapter brings the experience of tricresyl phosphate up to the present and concerns hydraulic fluids. Not very long ago a serious accident in a die casting shop sent lubricating engineers on a hunt for a safe hydraulic fluid. A line break in a hydraulic press shot mineral oil into the melting pot causing an explosion with resulting human injury and equipment damage. Nonflammable Lindol was a logical choice to replace the mineral oil and time showed that Lindol performed a remarkable service, efficiently and economically. A shop mechanic informed me recently that an installation of Lindol in his machines over a year ago was still in good condition requiring but small amounts of make-up occasionally. This is to be compared with periodical complete replacement when mineral oil is used.

From the foregoing synopsis one might conclude that tricresyl phosphate through its versatility is destined to hold a place in the ever changing world of chemistry. Its future as a synthetic oil additive

* *Presented before the March 15th, 1946, meeting of the New York Section of the A.S.L.E.*

TABLE I—PHYSICAL AND CHEMICAL PROPERTIES OF TRICRESYL PHOSPHATE

Specific Gravity @ 20C	1.160 ± .005 (9.70 lbs./gal.)
Acidity and Alkalinity	Neutral
Boiling Range 10mm HG	275-290C
Saponification	No effect after 16 hours
Flammability	Non-flammable
Stability	Not affected by metallic acids or salts
Pour Point	Below minus 25C
Flash Point	250C (does not support combustion)
Auto Ignition Temperature	Above 1000C
Surface Tension	43 dynes per cm
Viscosity @ 25C	80 cps or 285 Saybolt Seconds

might possibly grow further with more study and appreciation of its solvent power for carbon deposits and its use for breaking in purposes in new cars or reconditioned units.

The theory behind the performance of tricresyl phosphate as a synthetic lubricant has several explanations. Its physical and chemical properties are indicated in Table I . Tricresyl phosphate is a liquid mixture and its components vary only in the position of the alkyl radical attached to the benzene ring. Two forms predominate—the meta and para. The ortho is for the most part undesirable and the raw material is supplied with the ortho form practically removed. Figure 1 illustrates the structural formula and will also serve to indicate the basis for certain theoretical hypothesis. One form is a solid, the other liquid. The latter predominates so that we have tricresyl phosphate as a viscous liquid for hydraulic fluids or oil additives.

Diagrammatically, the reaction which results into tricresyl phosphate may be illustrated by Figure 2. I have used the alkyl group in the para position but the same replacement takes place if it were in the meta position.

Now, to the various theories as to what makes tricresyl phosphate tick:

1. It is believed that the grouping of the several benzene rings increases the surface area of each molecule so as to maintain a large surface area per molecule even under high pressure.

2. The alkyl radical of the molecule with respect to a horizontal film surface tends to increase the molecular thickness of the film preventing direct metal to metal contact between the moving surfaces.

3. Studies have also advanced the theory that the phosphate radical under high temperatures creates at the high points of wearing surfaces a metallic phosphide which melts into the indentations thereby forming a smooth surface.

4. Further, it is conceived by the compactness of the tricresyl phosphate molecule that the molecules act as ball bearings which resist compression, indeed, resist being mashed.

5. Still another theory suggests polar activity with the individual molecules attracted or held to the metallic surface by electromotive attraction or a static effect. Coupled with this interpretation is that of tricresyl phosphate acting as a wetting agent forming a cohesive film directly over the metal surface.

The use of tricresyl phosphate as a hydraulic fluid is a relatively simple application as compared to its use as an oil additive. There is no other liquid medium involved which the tricresyl phosphate must police, so to speak. As a hydraulic fluid it is the lubricant and safety factor all in one. As an oil additive it is expected to blend with the mineral oil to conform to the ever increasing demands for compactness, speed, power and acceleration in modern engines. In other words it must be compatible with lubricating compositions to extend and widen the limits of straight lubricating oil. Tricresyl phosphate is a good neighbor among anti-corrosive agents, detergents, oiliness agents, etc.

For engines in which high bearing pressures and temperatures require oil having marked load-bearing capacity and corrosion inhibiting tendencies, tricresyl phosphate and sulfurized sperm oil or other compositions containing a sulfurized mono-ester of a fatty acid give highly satisfactory results. The addition of .8% of the sulfurized sperm oil and a .8% of tricresyl phosphate to a lubricating oil enables the oil to withstand a bearing pressure above 18,000 psi by Almen test machine. Moreover, this mixture shows a lower rate of temperature rise of the bearings under given load conditions. A large number of lubricant additives have been suggested and are in use which increase the film strength five times or more over that of plain lubricating oil at temperatures up to 200C, and at the same time decrease the corrosive effect upon composite metal bearings. Also, the lubricant markedly resists oxidation and formation of carbonaceous and gummy deposits. Examples of a composition of these additives consists of metal soaps such as tin oleate, tricresyl phosphate and an organic phosphite in the ratio of .1%, .5%, and .1% respectively. The results were reported for such a combination are given in Table II.

TABLE II

Temp.	Load—Pounds/Square Inch: Plain oil	Plain oil plus 3 additives	Plain oil plus 5% tricresyl phosphate
30C	12,000	30,000	20,000
80C	8,000	20,000	18,000
160C	4,000	18,000	9,000
200C	3,000	16,000	3,000

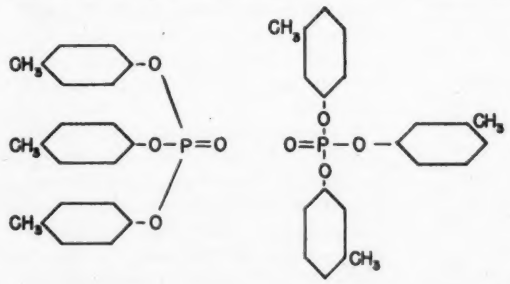


Figure 1
Para form
Solid
(35-40% in mixture)

Meta form
Liquid
(55-60% in mixture)

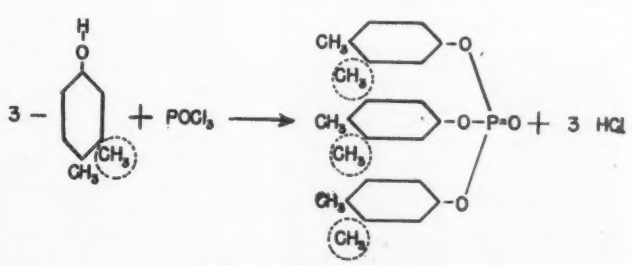


Figure 2

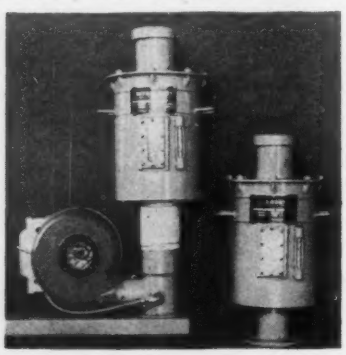
(Continued on page 26)

Tank Breathers

The Pittsburgh Lectodryer Corporation, Pittsburgh, Pa., announces an improved line of "Lectrobreathers," especially designed for all types of chemical and oil storage tanks. G. L. Simpson, vice president and general manager, points out in annoucing these breathers, that storage tanks are in effect giant lungs, breathing moisture-laden air in and out as temperatures change or tanks are filled or emptied. The moisture thus admitted to the tanks may cause corrosion of the tanks or contamination of the contents. The purpose of the Lectrobreather, Mr. Simpson says, is to eliminate this corrosion or pollution by removing the moisture from the air entering the tanks.

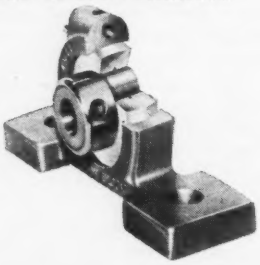
The breathers can be mounted either directly over the tank's vent or be piped to it. Incoming air is thoroughly dried by its passage through activated aluminas contained in the breather. The air exhaled by the tank is dry and has a partial reactivating effect, thus prolonging the periods between reactivations of the breather. The breathers are equipped with color indicators to show when reactivation is needed and when reactivation is complete.

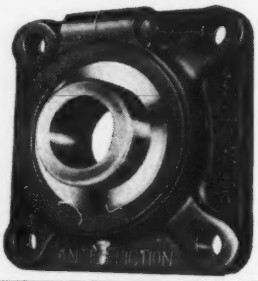
Factors to be considered in selecting a breather, according to the manufacturer, are the frequency and speed of emptying or filling the tank, the size of the tank, nature of contents, and weather conditions.



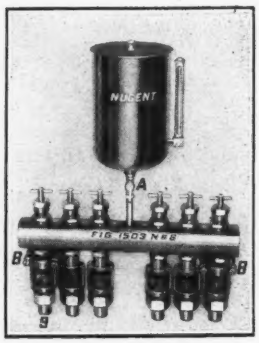
Pillow Blocks and Flange Units

The "Imperial" line of self-aligning bronze pillow blocks and flange units has been announced by the Anti-Friction Bearings Co., 2020 South Figueroa St., Los Angeles 7, Calif. Line sizes from 5/8 to 3-inch shaft diameters are available. A split housing of high tensile-strength aluminum carries a spherical naval bronze bearing, in which a ground adaptor sleeve is inserted, so that one basic pillow block can serve a number of shaft diameters.





Multiple Oiler



Wm. M. Nugent & Co., 410 N. Hermitage Avenue, Chicago, Ill., have recently announced their Fig. 1503N heavy-duty multiple oiler. It is said to be designed for use on any machine that requires drop feed or small-stream oil lubrication. It is available with from 2 to 23 sight feed valves, with union outlets available in sizes from 1/8 to 3/8 inch pipe size. Each sight feed has a strainer that can be removed without the use of tools and without stopping the flow of lubricant.

The reservoir tank has a capacity of three pints and is equipped with a dust-tight cover and sight gauge.

Synthetic Lubricant

(*Continued from page* 25)

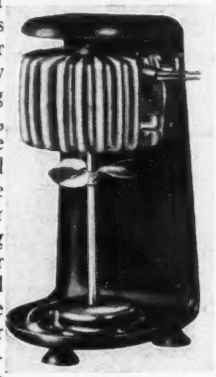
Another important consideration in connection with the use of additives is that when an engine is stopped, the oil film on the vertical surfaces soon drains off and when the machine is again started appreciable time elapses before the circulation provides oil for the formation of new lubricant films. An additive such as a phosphate ester, and in particular tricresyl phosphate when incorporated in the motor oil, causes a thin film which is tenaciously held to the metal and will prevent the separation of the oil film which will prevent wear and damage to the bearings when the motor is first started up. During the break-in period, the high pressure is further exaggerated.

Many additives tend to increase or accelerate sludge formation in oils to an objectionable extent. Some additives have a definite effect on the oil itself such as the stability and corrosiveness of the oil. Some, also, are not very soluble in lubricating oils.

Tricresyl phosphate is especially effective in dissolving deposits of gummy or resinous films upon piston rings, valves, and cylinder walls of engines especially when operated at relatively high temperatures or for long periods of time without changing oil. Five to ten per cent of tricresyl phosphate will disperse decomposition products of lubricants such as carbon, and dissolve excessive amounts of resinous or gummy substances which are formed after prolonged periods of use.

I have briefly outlined the stormy passage of Lindol in the ever-changing chemical industry and have presented probably controversial theories as to the molecular function of the compound. Without a doubt some of you lubricating engineers have your own pet oil additives, but I believe that I can safely take leave suggesting synthetic lubricant for pressure oil systems in the form of tricresyl phosphate.

Recirculating Pump



Scores of practical uses are claimed for the new Morey Recirculating Pump. Small, but sturdy, the pump is said to have ample capacity for circulating coolants for lathes and other machine tools and for all light industrial uses where small pumps are required.

The pump is only 10 inches high, with a shipping weight of 7 pounds. It has a water output of 2 gpm at 72-inch head; the outlet pipe is ¼ inch. The 1/50 hp motor is totally enclosed in an aluminum case and is cooled by an external fan. The stainless steel shaft is 5/16 inch diameter and has a left-hand thread to the impeller. The latter is made of brass and is designed for maximum output. The bearings are self-aligning, oilite type, sealed with oversize oil retainers, and oiled through outside oiling cups. The pump stand is made from 16-gauge steel, die formed, coated with vitreous porcelain. It is mounted on rubber vacuum feet for vibration dampening.

The pump is supplied in either 110 or 220 volts, 50/60 cycle, shaded pole 3350 rpm. It is manufactured by Dan Morey, 814 So. Robertson Blvd., Los Angeles 35, Calif.

Automatic Oil Lubricating System

A new engineering manual of interest to machine designers and maintenance engineers has recently been issued by the Lubrication Division of Rivett Lathe and Grinder, Inc., of Brighton, Mass. This manual brings the latest information on the Pulsolator Automatic Oil Lubricating Systems.

Rivett claims that a Pulsolator System can be engineered to meet almost all lubricating problems on industrial machinery. One system can be engineered to provide controlled oil delivery by gravity or under pressure to selected bearings and at the same time direct continuous flood lubrication to enclosed bearings and gear trains. The simplicity of design and the relatively limited piping involved are called to the attention of the designer.

The system may be built into new machines or installed on existing ones; it consists of a central pumping unit with reservoir, driven from a shaft on the machine or a separate motor, an oil supply line which runs from and returns to the pumping unit, and metering feeders mounted along the oil line in proximity to their respective bearings. The standard pumping units have reservoir capacities ranging from one quart to fifty-five gallons, and are capable of lubricating from one to four hundred bearings. Special units are available.

In operation, the pumping unit circulates a continuous flow of oil through the oil supply line and periodically builds up instants of high pressure, the frequency of which can be regulated. At the instant of high pressure the feeders mounted along the supply line open and meter predetermined quantities of oil to their respective bearings.

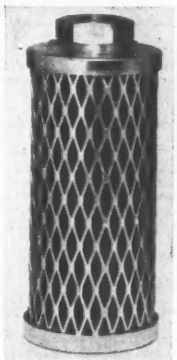
New Housing Seal for Roller Bearing Units

A newly designed housing seal for roller bearing units has been announced by the Shafer Bearing Corporation, 1412 West Washington Boulevard, Chicago 7, Illinois.

Called the "Z" Seal, this new device was developed to meet a universal need for a housing seal that would effectively retain lubricant and keep dirt out. The "Z" Seal consists of five parts. The seal element fits on an extension of the inner bearing race with minimum running clearance, providing an almost frictionless seal. The seal element is held under moderate tension yet is permitted to float radially, thus correcting for radial displacement from any cause. Brass construction is used in two parts to prevent corrosion and to provide natural bearing material during momentary contacts with the inner bearing race. The entire unit is easily removed and dissembled into its component parts. The "Z" Seal is furnished as standard equipment without extra charge on all Shafer Roller Bearing Units.

On the basis of performance in several thousand installations, the "Z" Seal has demonstrated an exceptional degree of efficiency. This entirely new type of seal has been adapted as standard equipment by many of the larger industrial plants and original equipment manufacturers. A descriptive folder is available on request.

Sump Filter



Marvel Engineering Co., 69 W. Washington St., Chicago 2, Ill., has announced the new Marvel Synclinal Filter. Said to have high filtering capacity because of greater filtering area and rounded corners which do not build up restrictions, it is available in 1 in. and 1¼-in. pipe size.

The assembly may be easily disassembled for cleaning, and is especially recommended for coolant and hydraulic systems on all types of machines using circulated oil for cutting, boring or grinding operations. The standard size opening in the filtering medium is .0050 in., but special inserts are available with larger or smaller openings.

PERSONNEL

Mr. Walter B. Archer, for many years connected with Specialized Lubricants activities in the Detroit area, has been appointed Detroit District Sales Manager for The Hodson Corporation of Chicago, Ill. Mr. Archer's activities in the past have been largely with the automotive interests and affiliations. With The Hodson Corporation's special line of products designed for Industrial lubrication, his activities will now extend into those fields. He will be located in 908 Fisher Building, Detroit 2, Mich.

The Hilliard Corporation of Elmira, New York, announces the appointment of Mr. S. L. Powers, 606 Williamson Building, Cleveland, Ohio, as their new representative in this area. Mr. Powers has had considerable experience in engineering, lubricating, and fuel oil purification and maintenance equipment, and is a member of the American Society of Lubrication Engineers.

OILS AND LUBRICANTS PATENT ABSTRACTS

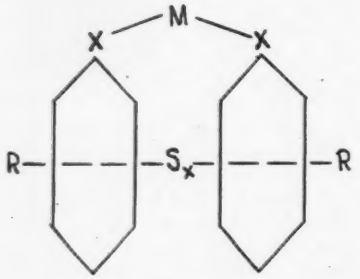
Substantially Oil Soluble Polyalkyl Aromatic Sulfonates—Patent #2,409,671—Jacob Faust, assignor to L. Sonneborn Sons, Inc. A new substantially oil-soluble polyalkyl aromatic sulfonate which consists of a substantially oil soluble polyamyl naphthalene sulfonate having one metal sulfonate radical carried by an unalkylated position of the aromatic ring and having at least three amyl radicals.

Compounded Lubricating Oil—Patent #2,409,686—John G. McNab and Dilworth T. Rogers, assignors to Standard Oil Development Co. A petroleum hydrocarbon material containing a small quantity, sufficient to stabilize said material of a reaction product of a sulfide of phosphorus with a compound of the formula

$$(RArX)_2M$$

where Ar is an aromatic nucleus, R is an alkyl radical having at least 5 carbon atoms, X is a member of the group consisting of oxygen and sulfur, and M is a divalent metal of group II of the periodic table and selected from the group consisting of calcium, barium, strontium, magnesium and zinc.

Sulfur and Metal Containing Compound — Patent #2,409,687—Dilworth T. Rogers and John G. McNab, assignors to Standard Oil Development Company. As a new composition of matter an oil-soluble sulfur containing product obtained by reacting elemental sulfur with a compound of the formula



Where R is an alkyl radical of at least 5 carbon atoms, X is a member of the group consisting of oxygen and sulfur, M is a divalent metal of group II of the periodic table and selected from the group consisting of calcium, barium, strontium, magnesium, and zinc, and x is an integer from 1 to 4.

Desulphurization of Hydrocarbon Oils—Patent #2,409,690—Edward W. S. Nicholson and Aaron K. Redcay, assignors to Standard Oil Development Co. A process for removing sulfur compounds from low boiling hydrocarbon oils which comprises continuously passing a mixture of hydrocarbon oil vapors and hydrogen through a treating zone, contacting the oil vapors within the treating zone with a desulfurizing catalyst, mantaining the vapors in contact with the catalyst for a period and at a temperature sufficient materially to reduce the amount of sulphur compounds contained in said oil but insufficient to form substantial carbon deposits on the catalyst, thereafter removing the treated vapors from the treating zone, continuously removing catalytic material from the treating zone while said material contains a relatively low concentration of sulfur, passing the catalyst so removed through a reactivating zone with a gas consisting substantially exclusively of hydrogen in an amount and at temperature sufficient to remove the sulfur from said catalyst and returning the desulfurized catalyst to the treating zone.

Lubricant Composition—Patent #2,409,726 — Carl Winning and John G. McNab, assignors to Standard Oil Development Co. A machinery lubricant suitable for use at high temperatures comprising a major proportion of a mineral oil base stock, a minor proportion, sufficient to impart substantial detergent properties to said lubricant, of a metal salt of a polybasic inorganic acid which contains at least one oil-solubilizing organic group, and a minor proportion, sufficient to inhibit varnish formation, of a higher alcohol.

Lubricant—Patent #2,409,799—Edward N. Roberts, assignor to Standard Oil Company. A lubricant composition containing an oil and in combination from about 0.001% to about 5% of a polyamino poly-aryl methane and from about 0.001% to about 10% of a neutralized phosphorus- and sulfur-containing reaction product of a phosphorus sulfide and a hydrocarbon.

Lubricating Oil—Patent #2,409,877—Robert L. May, assignor to Sinclair Refining Company. A lubricating oil composition comprising a major proportion of a petroleum lubricating oil and a minor proportion, effective to retard oxidation of the oil, of an inhibitor resulting from the reaction of an alkylated phenol with the condensation product of turpentine and phosphorus pentasulfide, the alkyl group of the alkylated phenol being a saturated aliphatic radical.

The abstracts shown in this issue are from Official Gazettes — Vol. 591, Nos. 4, 5; Vol. 592, Nos. 1, 2, 3, 4; Vol. 593, Nos. 1, 2, 3, 4, 5; Vol. 594, No. 1.

Printed copies of patents are available from the Patent Office at twenty-five cents each. Address the Commissioner of Patents, Washington, D. C., for copies and for general information concerning patents.

Lubricating Oil—Patent #2,409,878—Robert L. May, assignor to Sinclair Refining Company. A lubricating oil composition comprsng a major proporton of a petroleum lubricating oil and a minor proportion, effective to retard oxidation of the oil, of the reaction product of zinc oxide and an organic compound resulting from the reaction of an alkylated phenol with the condensation product of turpentine and phosphorus pentasulfide, the alkyl group of the alkylated phenol being a saturated aliphatic radical.

Process for Hydrobleaching Glycerine Oolls—Patent #2,410,102—William J. Paterson, assignor to Lever Brothers Co. A process for hydrobleaching glyceride oils to form edible products having a minimum of unsaponifiable components and an improved color and stability comprising treating the oil at a temperature of from 130 to 250 with hydrogen under a relatively high pressure in the neighborhood of 100 atmospheres, for a period of time not substantially greater than 60 minutes and in the presence of not substantially more than 0.5% of a catalyst having the general formula X—Y—O, in which X represents at least one metal selected from the group consisting of copper and silver, and Y represents at least one metal selected from the group consisting of chromium, vanadium, tungsten and uranium.

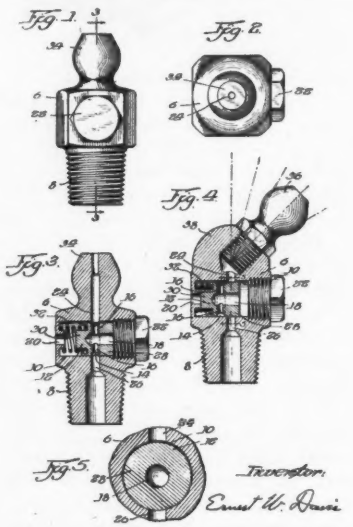
Lubricant—Patent #2,410,346—James Franklin Hyde, assignor to Corning Glass Works. The method of lubricating relatively moving metallic bodies which comprises maintaining between their bearing surfaces a lubricant film comprising a liquid polymeric organo-siloxane whose organic substituents consist essentially of lower alkyl and phenyl radicals attached to silicon through carbon-silicon linkages, said siloxane containing at least 40 mol. per cent of the recurring structural unit corresponding to the formula (C_6H_5) RSiO where R is a lower alkyl radical.

Lubricating Oil Composition—Patent #2,410,381—Vance N. Jenkins, assignor to Union Oil Co., of California. A lubricating oil composition comprising about 25% to about 99% by weight of a mineral lubricating oil and about 1% to about 75% by weight of a synthetic lubricating oil blending agent having a viscosity above about 10,000 seconds Saybolt Universal at 210 F, said lubricating oil blending agent being produced by chlorinating paraffin wax, dechlorinating said chlorinated paraffin at temperatures between about 400 F and 600 F to cause dechlorination without effecting substantial polymerization thereby producing wax olefins, distilling the wax olefins to remove therefrom polymerized material formed during the dechlorination step, catalytically polymerizing the polymer-free wax olefins and subsequently extracting said polymerization product with a normally gaseous hydrocarbon solvent having more than two and less than five carbon atoms per molecule and having a high solvent power for paraffin wax and wax olefins and a low solvent power for said lubricating oil blending agent at the temperature of extraction to separate a solution of paraffin wax and wax olefins in said solvent from said lubricating oil blending agent.

Manufacture—Patent #2,410, 382 — Saul Kaplan, assignor to Onyx Oil and Chemical Company. An oil-in-water emulsion having, as the disperse phase, a monoester of a glycol having from 2 to 3 carbon atoms with a higher fatty acid having 10 to 14 carbon atoms, and a continuous phase comprising an aqueous solution of a film-forming protective colloid, and a water-soluble organic carboxylic compound selected from the group consisting of carboxylic acids and their acidic reacting salts.

Method of Preserving Vitamin-Containing Oils—Patent #2,410,455—Sidney Musher, assignor to Musher Foundation, Inc. A method of preserving glyceride oil containing vitamins which comprises emulsifying them in molasses and heating to over 150 F whereby an enhancement of antioxygenic effect is obtained.

Lubricant Fitting—Patent #2,410,480 — Ernest W. avis, assignor to Stewart-Warner Corp. A pressure-controlling lubricant receiving fitting comprising a body having an inlet, an outlet, a vent port, and having a cylinder in communication with the vent port and providing a connection between the inlet and outlet; a piston fitting loosely in said cylinder and having the face thereof opposite the vent port subjected to the pressure of lubricant supplied through the inlet port, said piston providing a passageway normally connecting the inlet and outlet, and a spring normally holding said



piston away from the vent port, said piston being operable when the lubricant pressure at the outlet exceeds a predetermined value to move against the force of the spring and thereby cut off communication between the inlet and the outlet, said piston having a substantially flat valve face operable to close said vent port when said piston is moved to the end of its stroke by the application of said predetermined pressure.

Mineral Oil Composition—Patent #2,410,578—John J. Giammaria, assignor to Socony-Vacuum Oil Co., Inc. A mineral oil composition comprising a viscous mineral oil fraction having in admixture therewith a minor porportion, sufficient to depress the pour point of said oil fraction, of a lignin ester of an aliphatic acid having at least about 16 carbon atoms.

Hydraulic Liquid Having a Comparatively Small Change in Viscosity — Patent #2,410,608 — John D. Morgan, assignor to Cities Service Oil Co. A hydraulic liquid having a freezing point below about minus 50 F and a comparatively small change in viscosity in the temperature range between minus 40 F and 200 F, consisting substantially entirely of a trialkyl phosphate having dissolved therein about 1% by volume of a corrosion-resisting agent and about 0.25% by volume of a pour point depressant.

Lubricant—Patent #2,410,610—Armand D. Pickett, assignor to Phillips Petroleum Co. A lubricant consisting of a mixture of aluminum soap and lead soap in the ratio of the order of three to one by weight.

A lubricant consisting of a mixture of aluminum soap and lead soap in the proportion weight ratio of about three to one dissolved in sufficient solvent therefor to permit grease gun use, said lubricant being substantially insoluble in acids and petroleum hydrocarbons.

Flushing Oil—Patent #2,410,613—Robert F. Ruthruff. A flushing oil for cleaning the crankcases of internal combustion engines comprising, a fraction from the products of the catalytic reforming of heavy naphtha, said fraction boiling in the approximate range 400 F to 535 F and exhibiting a kauri-butanol value in excess of 100, in admixture with a mineral lubricating oil.

Lubricant Composition—Patent #2,410,650—John J. Giammaria, assignor to Socony-Vacuum Oil Co., Inc. A lubricant composition comprising a major proportion of a viscous hydrocarbon oil and an oil-miscible metal salt

of a wax-phenyl-substituted thio acid of phosphorous in an amount sufficient to exert detergent and anti-corrosive properties in the oil under heavy duty service, said wax group containing at least twenty carbon atoms.

Compounded Lubricating Oil—Patent #2,410,652—John R. Griffin, Jr., and Paul R. Van Ess, assignors to Shell Development Co. A low ash content lubricating oil for high temperature internal combustion engines containing an oil miscible metal salt of the condensation product of an aldehyde and an aromatic hydroxy compound in amount sufficient to give high temperature detergent action, but not exceeding about 0.25%, based on sulfate ash, and an oxidation-inhibiting quantity of an oil-soluble, relatively stable aromatic amine anti-oxidant.

Hydrogenated Oil Composition—Patent #2,410,715—Frank M. Clark, assignor to General Electric Co. A range of dielectric compositions consisting of about 99 to 85 per cent of hydrogenated vegetable oil and about 1 to 15 per cent of aromatic sulfone.

Condensation Products and Methods of Preparing and Using Same — Patent #2,410,885 — Eugene Lieber, assignor to Standard Oil Development Co. A composition comprising a major proportion of a waxy mineral lubricating oil and a small but pour depressing amount of a high molecular weight product substantially non-volatile up to about 600 F under reduced pressure, soluble in waxy mineral lubricating oil and having the property of depressing pour point thereof when added thereto in small amounts, said product being a Friedel-Crafts re-condensation product of only the high molecular weight oil-soluble pour depressing fraction substantially non-volatile up to about 600 F under reduced pressure of an initial Friedel-Crafts condensation product of a long chain aliphatic compound containing a reactive group selected from halogen atoms and olefin bonds, said re-condensation product having better pour depressing properties than said initial condensation product.

Process of Preparing a Lubricating Oil Solution of a Condensed Organic Amino Compound—Patent #2,410,911—Jones I. Wasson and Warren M. Smith, assignors to Standard Oil Development Co. The process of preparing a lubricating oil solution of a resin which comprises reacting a phenol containing an alkyl side chain of five to eight carbon atoms and at least one replaceable hydrogen atom in its nucleus with hexamethylenetetramine in the presence of a solvent consisting essentially of a mineral oil of the lubricating oil range at a temperature of about 110 to about 150 C for a period of about 4 to about 20 hours until about 10 to about 75% of the original nitrogen content of the reactants is eliminated.

Fatty Oil Deliming Process—Patent #2,410,926—William A. Bush and Edward A. Lasher, assignors to California Flaxseed Products Co. The process of deliming a fatty oil comprising mixing into said oil a substantially saturated water solution of a solid acid selected from the group consisting of sulfamic acid, oxalic acid, citric acid, picric acid and maleic acid in an amount sufficient to break the slime dispersion, mixing into said mixture a solid filteraid powder in amount sufficient to absorb all of said water solution remaining after mixing with the fatty oil, and filtering out said filteraid, acid and water with the slime from the purified oil.

Oil Desalting and/or Dewatering—Patent #2,410,970—Jesse A. Guyer, assignor to Phillips Petroleum Co. The method of desalting and/or dewatering an oil comprising the steps of placing the oil under pressure, adding water and gas, mixing the oil, water and gas together, heating the mixture, ejecting the mixture into a region of sufficiently reduced pressure to permit formation of gas bubbles, and separating the oil from the water and gas.

Lubricant—Patent #2,411,032—Ernest F. Engelke and William W. Odell, assignors to Lion Oil Co. A lubricant suitable for use in an internal combustion engine, comprising a major proportion of an oil having lubricating characteristics and a minor proportion of an additive sufficient in quantity to prevent oxidation of the lubricant, the sticking of piston rings and the corrosion of bearings, said additive comprising a phosphorized mixture of a soap and a higher molecular monohydric alcohol, said soap being derived from a heavy metal and a member of a group consisting of natural waxes and artificial wax mixtures obtained in the catalytic oxidation of high molecular hydrocarbons of paraffinic crudes, the mixture being phosphorized by the use of a member of a group consisting of elemental phosphorus and phosphorous pentoxide.

Oil Blend—Patent #2,411,150—Hector C. Evans and David W. Young, assignors to Standard Oil Development Co. A lubricating oil comprising a hydrocarbon lubricating oil blended with about 1% to 5% by weight of a polybutene viscosity index improving thickener and homogeneously blended with about 4 to 50% by weight of a substantially non-volatile oxy-ester which is a non-solvent for said polybutene at temperatures below 100 F as shown by its ability to precipitate polybutene from a 10% solution thereof in a light hydrocarbon solvent when added at room temperature in amounts of from about 20 to 300% based on said solution, said oxy-ester being homogeneously dissolved in the thickened blend to substantially reduce the viscosity thereof at 100 F and increase the viscosity index of the thickened oil blend.

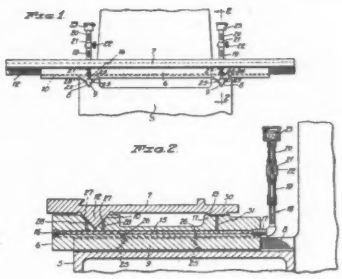
Mineral Oil Composition and Improving Agent—Patent #2,411,153—Everett W. Fuller and Henry G. Berger, and Robert H. Williams, assignors to Socony-Vacuum Oil Co., Inc. An improved mineral oil composition comprising a viscous mineral oil and in admixture therewith a minor proportion, from about 0.1 per cent to about 5 per cent, of an oil-soluble, phosphorous—and sulfur-containing reaction product obtained by reaction of substantially one mol of phosphorus pentasulfide and four mols of oleyl alcohol at a temperature from about 125 C to about 150 C, the reaction time-reaction temperature relationship being so maintained that the acidity of said reaction product is not greater than about 25.

Lubricant—Patent #2,411,159 — William Edward Hanford, assignar to E. I. duPont deNemours and Co. A lubricating composition comprising the reaction product of tetrafluoroethylene with a saturated non-polymerizable organic compound of the general formula XY where X is a member selected from the group consisting of hydrogen and halogen and Y is a monovalent saturated organic radical, said reaction product consisting of from two to about 25 tetrafluoroethylene units per unit of organic compound.

Beneficiating Mineral Oils—Patent #2,411,160—Everett C. Hughes, assignor to The Standard Oil Co. A mineral oil beneficiated with a small amount of the reaction product of cashew nut shell oil and phosphorus pentasulphide.

Oil Composition—Patent #2,411,178 — David W. Young and Eugene Lieber, assignors to Standard Oil Development Co. A composition composition comprising a major proportion of a paraffinic hydrocarbon, and dissolved therein a small amount of dicarboxylic-glycol polyester having a molecular weight of at least 2000, there being at least 10 carbon atoms per molecule in at least one of said two reactants and the total number of carbon atoms in 1 molecule of the dicarboxylic acid together with 1 molecule of the glycol being at least 30, and a small amount of a pour depressor consisting essentially of a high molecular weight condensation product of a long chain aliphatic compound and an aromatic compound.

Lubricating System—Patent #2,411,491 — Ladislaus Robaczynski. A lubricating system for lubricating a plurality of machine parts having relative movement through the medium of interengaging tracks and trackways having opposed contacting faces, said system including a plurality of open recesses disposed obliquely in one of said opposed contacting faces the open sides of which recesses are, under operating conditions, closed

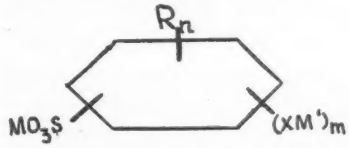


by the opposed contacting face, and gravity feed means carried by one of the movable machine parts for supplying lubricant to said recesses.

Treatment of Mineral Oils—Patent 2,411,502—Lawton A. Burrows ,assignor to E. I. duPont deNemours and Co. The process of treating mineral oils and separating various constituents therein contained, which comprises mixing the mineral oil with nitrocyclohexane and effecting substantial solution therebetween, cooling the solution to a temperature at which segregation into more than one portion results, and separating said segregated portions.

Condensation Product and Method of Preparing and Using Same—Patent #2,411,579—Eugene Lieber and Marvin E. Thorner, assignors to Standard Oil Development Co. A lubricating composition comprising a major proportion of a waxy mineral lubricating oil and a wax-modifying amount of a Friedel-Crafts condensation product of a lower saturated aliphatic ether having the general formula R—O—R', where R and R' are alkyl groups having a total of less than 10 carbon atoms with an aromatic compound selected from the group consisting of aromatic hydrocarbons and alkyl, hydroxy, amino, and partially hydrogenated derivatives thereof, said condensation product being non-volatile up to 500 F under reduced pressure, soluble in mineral oil and having wax-modifying properties.

Compounded Lubricating Oil—Patent #2,411,583—John G. McNab and Carl Winning, assignors to Standard Oil Development Co. A composition of matter comprising a hydrocarbon oil subject to deterioration at elevated temperatures and a small proportion, sufficient to substantially stabilize said oil at such elevated temperatures of a compound having the formula—



Where M and M' are metals selected from groups II, III, VIII and the right-hand column of group IV of the periodic table, X is a member of the class consisting of oxygen, sulfur, selenium, and tellurium, R is a branched chain alkyl radical, and m and n are small whole numbers whose sum is not greater than 5, the total number of carbon atoms in all of the R groups being at least 8.

Anti-Friction Bearing Lubricant—Patent #2,411,587—Arnold J. Morway and Alan Beerbower, assignors to Standard Oil Development Co. An unctuous, transparent anhydrous grease containing from .03-.06% free alkalinity as NaOH and composed of mineral lubricating oil

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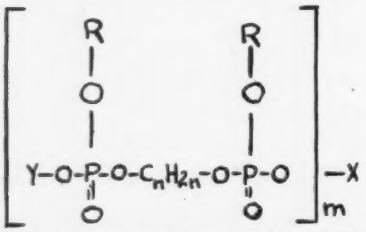
thickened to smooth grease consistency with a mixture of soda and zinc soaps in which the ratio of soda to zinc is between 14:1 and 28:1.

Mineral Oil Composition Resistant to Foaming—Patent #2,411,671—Herschel G. Smith and Troy L. Cantrell, assignors to Gulf Oil Corp. A mineral oil composition resistant to foaming comprising a major amount of a mineral oil and an amount at least sufficient to reduce the foaming tendency of said oil of a salt of an alkyl alkylene diphosphate having the following formula:



wherein R represents an alkyl group containing 1 to 18 carbon atoms, Y is a substituent of the class consisting of monovalent metals and alkyl groups, X represents a constituent of the class consisting of metals and an organic ammonium group derived from the class consisting of heterocyclic nitrogen bases and dialkylaryl amines, m is a number corresponding to the valence of X, and n is 2 to 6.

Infrared Treatment of Oils—Patent #2,411,767—William A. Waldie and Harry A. Toulmin, Jr., assignors to New Wrinkle, Inc. The method of bodying a vegetable drying oil selected from the group consisting of tung oil and crude oiticica oil which consists in exposing said oil to light consisting essentially of infra-red radiations of such intensity whereby the time required to obtain a given degree of body is substantially reduced.

Method of Producing Dry Metal Sulfonates of Improved Oil Solubility—Patent #2,411,819—Earl Arnott, assignor to Union Oil Co. of California. A method of producing dry metal sulfonates of improved oil solubility from an oil solution of said sulfonates, which comprises adding to said solution an oil soluble high molecular weight hydrocarbon material which is substantially insoluble in liquid propane at about 190 F in an amount sufficient to improve substantially the oil solubility of said sulfonates, agitating the resulting mixture and heating it to a temperature between about 120 F and about 204 F, in the presence of a liquefied normally gaseous hydrocarbon, whereby two phases are formed, one a liquid phase comprising substantially sulfonate-free oil dissolved in said normally gaseous hydrocarbon and the other a solid phase comprising the desired dry sulfonates containing said high molecular weight hydrocarbon material, settling and separating said phases.

Method of Purifying Petroleum Products — Patent #2,411,958—Melvin A. Dietrich and Charles J. Pedersen, assignors to E. I. duPont deNemours and Co. The method of purifying petroleum products contaminated with dissolved catalytically active compounds of copper which comprises washing the petroleum product in the liquid state with a dilute aqueous solution of sodium thioglycolate.

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Method of Purifying Petroleum Products—Patent #2,411,959—Melvin A. Dietrich and Charles J. Pedersen, assignors to E. I. duPont deNemours and Co. The method of purifying petroleum products contaminated with dissolved catalytically active compounds of heavy metals selected from the group consisting of copper, iron, cobalt, manganese, and vanadium which comprises washing the petroleum product in the liquid state with a dilute aqueous solution of a member of the group consisting of thiourea, thiosemicarbazide, N-guanylthiourea, beta-amino ethyl mercaptan and dithiourea.

Cutting Oil—Patent #2,412,082—Paul P. Gabriel. A lubricant or cutting oil composition comprising 25% to 40% by volume of carbon tetrachloride and 75% to 60% by volume of the reaction product of approximately 88 parts of lard oil, 12 parts of sulphur and 2 parts of pine oil, the composition being aged at approximately 70F for a period of about two weeks.

Cutting Oil—Patent #2,412,131—Thaddeus Williamson Culmer, assignor to The Ohio Oil Company. A chlorinated sulfurized sperm oil cutting oil which yields active sulfur under conditions of normal use, said cutting oil containing from about 0.5% to about 1.0% of lecithin to prevent such active sulphur from causing stains.

Treating Fatty Oils—Patent #2,412,176—Alexander Schwarcman, assignor to Spencer Kellogg and Sons, Inc. A process of manufacturing improved drying oils from semi-drying oils which comprises heating a mixture comprising a major proportion of a semi-drying oil and a minor proportion of a drying oil with approximately from 1 to 7 per cent on the weight of the oil of a polyhydric alcohol until reaction is substantially complete and esterifying the reaction product with approximately 1 to 7 per cent on the weight of the oil of a polybasic acid of the class consisting of polycarboxylic acids and their anhydrides, to form an oil of low acid number.

Drying Oil Manufacture—Patent #2,412,177—Alexander Schwarcman, assignor to Spencer Kellogg and Sons, Inc. A process of manufacturing improved drying oils capable of bodying rapidly to a fast drying product, which comprises heating a fatty oil having drying properties with approximately from 1 to 7 per cent on the weight of the oil of a polyhydric alcohol until reaction is substantially complete and esterifying the reaction product with approximately 1 to 7 per cent on the weight of the oil of a polybasic acid of the class consisting of polycarboxylic acids and their anhydrides, to form an oil of low acid number.

Purification of Oil—Patent #2,412,251—Benjamin Clayton, assignor, by mesne assignments, to Benjamin Clayton, doing business as Refining, Unincorporated. The process

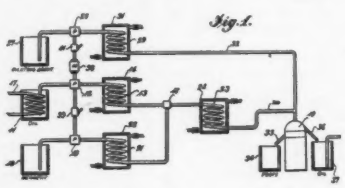

Fig. 1.

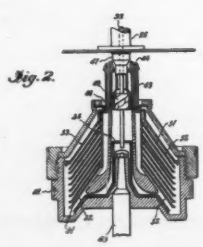

Fig. 2.

of purifying vegetable and animal oils containing impurities, including free fatty acids, which comprises, mixing therewith an alkaline refining reagent capable of reacting with said impurities to precipitate the same and produce soap, said reagent being added in sufficiently high concentration to produce a stratified mixture including an oil phase, a soap phase, and an aqueous phase when the mixture is subjected to centrifugal separation, thus interfering with said separation, reducing concentration by adding an aqueous diluent to said mixture insufficient quantity to overcome such stratification, whereby to permit said soap to be discharged with said aqueous layer, and centrifugally separating the thus conditioned mixture.

Refining of Low-Grade Hydrocarbon Oils—Patent #2,412,427—Elmer H. Records. The new method of refining low-grade hydrocarbon oils and which comprises the steps of pre-heating the oil to a temperature of between 400F and 700F depending upon the determined vaporization point and supplying this preheated stock to a retort in quanity sufficient to charge the latter to approximately one-third of its total capacity; sealing the charge and applying heat to develop a pressure condition of approximately 200 p s i and then injecting a spray of supplementing hot oil through the produced gases while passing off and condensing such portion of the evolved vapors as becomes necessary to maintain said given pressure condition; terminating the spray injection as pressure drops off, and passing off and condensing the remaining vapors while continuing to apply heat; again sealing the oil contained in the retort and allowing pressure to build up to approximately 850 p s i, whereupon vapors evolved from such high pressure treatment are passed off and condensed and the residue dropped to a subjacent holding tank held at a temperature approximating 600 F; performing the described steps repetitively and, from the aggregate of the dropped residues, periodically drawing off the very heavy settlings; and repeatedly processing lighter portions of the dropped residues by performing cyclic operations of returning successive charges of said lighter portions to the retort, repressuring the same therein to an approximate 850 p s i, passing off and condensing the evolved vapors, and again dropping the residue from each said repressuring step to the holding tank.

Lubricating Oils—Patent #2,412,557—Charles M. Blair, Jr., assignor to Petrolite Corp., Ltd. A lubricating composition, comprising a lubricating oil and an unsaturated amine-alpha-beta, unsaturated carboxylic acid addition-condensation polymer; said amine containing at least one ethylenic unsaturation and having at least 4 singly bonded carbon atoms between the ethylenic double bond and the nearest amine nitrogen atom, said amine having at least one hydrogen atom directly linked to an amino nitrogen atom, and containing less than 32 carbon atoms per nitrogen-attached hydrocarbon group; said acid containing less than 10 carbon atoms and free from vinyl radicals; said polymer being mixed with said lubricating oil in an amount within the range of .025% to about 5%.

Lubricant—Patent #2,412,634—Murray L. Schwartz, assignor to Standard Oil Company. A composition of matter comprising about 5% to about 40% of a soap of a preferentially oil-soluble petroleum sulfonic acid, about 0.5% to about 10% of a castor compound selected from the group consisting of castor oil, castor amide and glycerol monoricinoleate, and a major proportion of a hydrocarbon lubricating oil.

Lubricant — Patent #2,412,688 — Charles B. Large, Maurice J. Zucrow, and Robert L. Hirsch, assignors to Aerojet Engineering Corp. A lubricant which retains its lubricating qualities in the presence of strong mineral acids and which comprises a solution of about 1% to 9% chlorinated natural rubber in a polychloropane liquid.

Lubricating Oils—Patent #2,412,708—Charles M. Blair, Jr., assignor to Petrolite Corp., Ltd. A lubricating oil composition, comprising a lubricating oil and an alpha-beta, unsaturated carboxylic acid amine mixture addition-condensation polymer; said polymer being the reaction product of (A) an unsaturated amine containing at least one amino hydrogen atom and at least one ethylenic unsaturation and having at least 4 singly-bonded carbon atoms between the ethylenic double bond and the nearest amino nitrogen-atom; and containing less than 32 carbon atoms per nitrogen attached hydrocarbon group in admixture with a saturated amine containing at least one amino hydrogen atom, free from aryl radicals and containing less than 32 carbon atoms per nitrogen-attached hydrocarbon group; and (B) an alpha-beta, unsaturated, polycarboylic acid containing less than 10 carbon atoms and free from vinyl radicals; said polymer being mixed with said lubricating oil in an amount within the range of 0.025 to about 5%.

Method for Purifying Mineral Oils—Patent #2,412,791—Logan C. Waterman, assignor to Petrolite Corp., Ltd. A process for removing water-dispersible impurities from an oil, which process includes the steps of: continuously mixing with a stream of said oil a stream of relatively fresh water to form a stream of artificial oil-continuous emulsion; dividing the resulting stream of oil-continuous emulsion into a plurality of separate streams; establishing a plurality of separate high-intensity coalescing electric fields in a plurality of separated settling spaces disposed approximately at the same level, the number of fields and the number of settling spaces corresponding to the number of said separate streams; delivering said separate streams respectively to said high-intensity electric fields to coalesce the dispersed water and bring the water-dispersible impurities into association therewith; separating the electrically-treated constituents of each separate stream in its corresponding settling zone to produce therein bodies of purified oil and separated water, said separated water now containing in large measure the water-dispersible impurities; withdrawing streams of oil from the upper ends of said settling zones and combining these streams; throttling the combined stream of purified oil while increasing and decreasing the throttling action in response to changes in pressure of said combined stream at a position upstream from the throttling position and in a manner to maintain the pressure in said settling zones substantially constant; withdrawing streams of water simultaneously from each of said settling zones and combining these streams; and controlling the rate of flow of water in the combined stream of water in response to changes in the total amount of separated water in only one of said separating zones and in a manner to maintain the total amount of separated water in this one of said separating zones substantially constant.

Compounded Lubricating Oil—Patent #2,412,903—Robert J. Miller and John T. Rutherford, assignors, by mesne assignments, to California Research Corp. A compounded lubricant comprising a major portion of hydrocarbon lubricating oil, from about 0.1 to about 5% by weight based on the compounded lubricant of an oil-soluble alkaline earth metal phenate and from about 0.1 to 5% by weight based on the compounded lubricant of an oil-soluble zinc thiocarbamate.

Process for Preparing Petroleum Sulfonates—Patent #2,412,916—Jere C. Showalter, assignor to Standard Oil Development Co. A method for producing a detergent suitable for use as a shampoo comprising the steps of extracting a naphthenic distillate having a viscosity in the range of 75 to 85 seconds Saybolt at 100F with a selective solvent under conditions to form a raffinate and an extract, contacting the extract with concentrated sulfuric acid in the range of 300 to 400 pounds of acid per barrel of extract under conditions to form a sludge layer and a sulfonated oil layer, separating the sludge layer, adding from 3% to 5% of water to the sulfonated oil layer and settling to produce an oil layer and a sulfonic acid layer, withdrawing the sulfonic acid layer and contacting it with a solution of an alkali metal hydroxide to form a soap, mixing the soap with isopropyl alcohol, extracting the mixture with a light hydrocarbon, distilling the extracted soap to remove alcohol and light hydrocarbon therefrom and settling to form a layer of water-insoluble soap and a layer of water-soluble soap and removing the water-soluble soap as product.

Lubricant—Patent #2,412,929—Leonard G. Vande Bogart and Robert W. Manuel, assignors to Crane Co. A grease-like lubricant comprising 5 to 45% castor oil and 5 to 45% petroleum oil, the said oils being in such proportions and character that they are not mutually soluble, bentonite clay, and a non-aqueous and soap free liquid stabilizing agent consisting of the lower alkyl phosphate group such as triethyl and tributyl phosphate, the amount of the oils present being greater than that represented by the oil-absorption value of the bentonite clay, the amount of the said liquid stabilizing agent being sufficient to prevent a separation of the bentonite clay and the said oils into two distinct solid and liquid phases.

Lubricant Containing Alkyl Piperidine Salts—Patent #2,412,956—George E. Barker, assignor to Elgin National Watch Co. A lubricant consisting of an organic lubricant liquid having dissolved therein from 0.05 to 1.0 per cent of an alkyl-piperidine salt of a fatty acid, the alkyl group having from 5 to 30 carbon atoms and the acid group having from 5 to 30 carbon atoms.

Lubricants, Etc. — Patent #2,413,188 — John M. Musselman and Herman P. Lankelma, assignors to The Standard Oil Co. A lubricant capable of maintaining desirable body and clean metal surfaces under heat and drastic usage, consisting of a mineral lubricating oil containing about 0.1-10 per cent of a salt of an oxy-sulphur acid, of the formula $R.SO_4.R^1$ wherein R is an alkyl or halogen substituted alkyl radical, and R^1 is a base.

Wire Drawing Method—Patent #2,413,220—Flint C. Elder and Arch W. Harris, assignors to The American Steel and Wire Co. of N. J. The process of drawing wire which comprises passing wire through a drawing die in the presence of a wire-drawing lubricant comprising an aqueous suspension of a water-insoluble metallic stearate, the said suspension containing not more than 2% by weight of the insoluble stearate, and not more than substantially 0.2% of a wetting and dispersing agent.

Lubricant and Process for Preparing Same—Patent #2,413,311—Charles A. Cohen, assignor to Standard Oil Development Co. The process which comprises contacting a finely divided siliceous filter aid selected from the group consisting of diatomaceous filter aids, tripoli, and finely ground silica, with an acid-treated oil containing pre-formed pepper sludge in dispersion, dissolved sulfur dioxide, and oil-soluble sulfonic acids having a combining weight of at least 400 to co-precipitate the pepper sludge with the filter aid, removing co-precipitated pepper sludge and filter aid from the oil, removing dissolved sulfur dioxide from the oil, and thereafter neutralizing the oil-soluble sulfonic acids with a basic compound of polyvalent metal to form soluble sulfonates of said metal in the acid-treated oil from which pepper sludge and sulfur dioxide have been removed.

Composition of Matter Suitable for Use as a Lubricant and Lubricant Comprising the Same — Patent #2,413,332—John M. Musselman, assignor to The Standard Oil Company. A composition of matter suitable for use as a lubricant and as an addition agent in an amount to improve the characteristics of lubricating oils and greases, comprising the reaction product of a phosphorus sulfide and an oxygen-containing wax, in admixture with a plural metal compound of said reaction product.

Cutting Oil Composition—Patent #2,413,353—Benjamin F. Hunter and Harold P. Hobart, assignors to Gulf Oil Corp. An improved cutting oil composition comprising at least about 50.0 per cent by weight of a light mineral oil boiling above about 350F and having a viscosity not greater than about 40 SUV at 100F, from about 1.0 to about 20.0 per cent by weight of a mineral oil having a viscosity between about 100 and and about 200 SUV at 210F, from about 0.5 to about 15.0 per cent by weight of a fixed fatty oil, from about 0.03 to about 5.0 per cent by weight of a petroleum oil anti-oxidant, and up to about 10.0 per cent by weight of the residue which remains after removal of the solvent from the extract obtained by extracting a petroleum distillate oil with a solvent capable of removing polycyclic hydrocarbons and sulfur compounds from petroleum distillate oils, said residue having a viscosity between about 55 and about 70 SUV at 210F.

Oil Modified Resin Compositions—Patent #2,413,412—Arthur P. Mazzucchelli, assignor to Bakelite Corp. Process of preparing an oil modified resinous composition which comprises reacting at a temperature ranging from 115° C to 215° C a normally oil insoluble, dehydrated Novolak phenol-aldehyde resin with a fatty material selected from the group consisting of raw fatty oils, oxidized fatty oils, heat polymerized fatty oils, dehydrated fatty oils, hydrogenated fatty oils and fatty acids having at least 7 carbon atoms and in the presence of an acidic catalyst selected from the group consisting of the hydrates of phosphorus pentoxide, dialkyl sulphates,

$$Ca(SO_4) \cdot H_2SO_4$$

sulphur trioxide and its compounds having the formula $R—SO_3H$ wherein R is a radical selected from the group consisting of halogen, hydroxyl and aryl radicals and OX wherein X is an alkyl radical, said catalyst calculated as phosphoric acid or sulphuric acid being present in amount between 0.1 and 4.0 per cent by weight of the Novolak resin.

Lubricant—Patent #2,413,718—Bert H. Lincoln and Gordon D. Byrkit, assignors to Continental Oil Co. A lubricant comprising in combination a major proportion of a hydrocarbon oil and from .001% to about 20% of an oil soluble halogen-bearing ester containing at least one carbon-boron bond.

Rust-Inhibiting Lubricant — Patent #2,413,852 — William R. Turner, assignor to The Atlantic Refining Co. A lubricant comprising hydrocarbon oil and a rust-inhibiting quantity of an oil soluble reaction product of an alkyl acid phosphate having from 8 to 16 carbon atoms in the alkyl group and a branched-chain alkylamine containing from 4 to 16 carbon atoms in the alkyl group.

Lubricant—Patent #2,413,972—Robert D. Herlocker and Milton Paul Kleinholz and Franklin M. Watkins, assignors to Sinclair Refining Co. An improved turbine oil which comprises a petroleum lubricating oil containing a minor proportion, effective to retard rusting of metal parts, of a compound of the class consisting of tris-(morpholinomethyl)-phenol and bis-(morpholinomethyl)-phenol.

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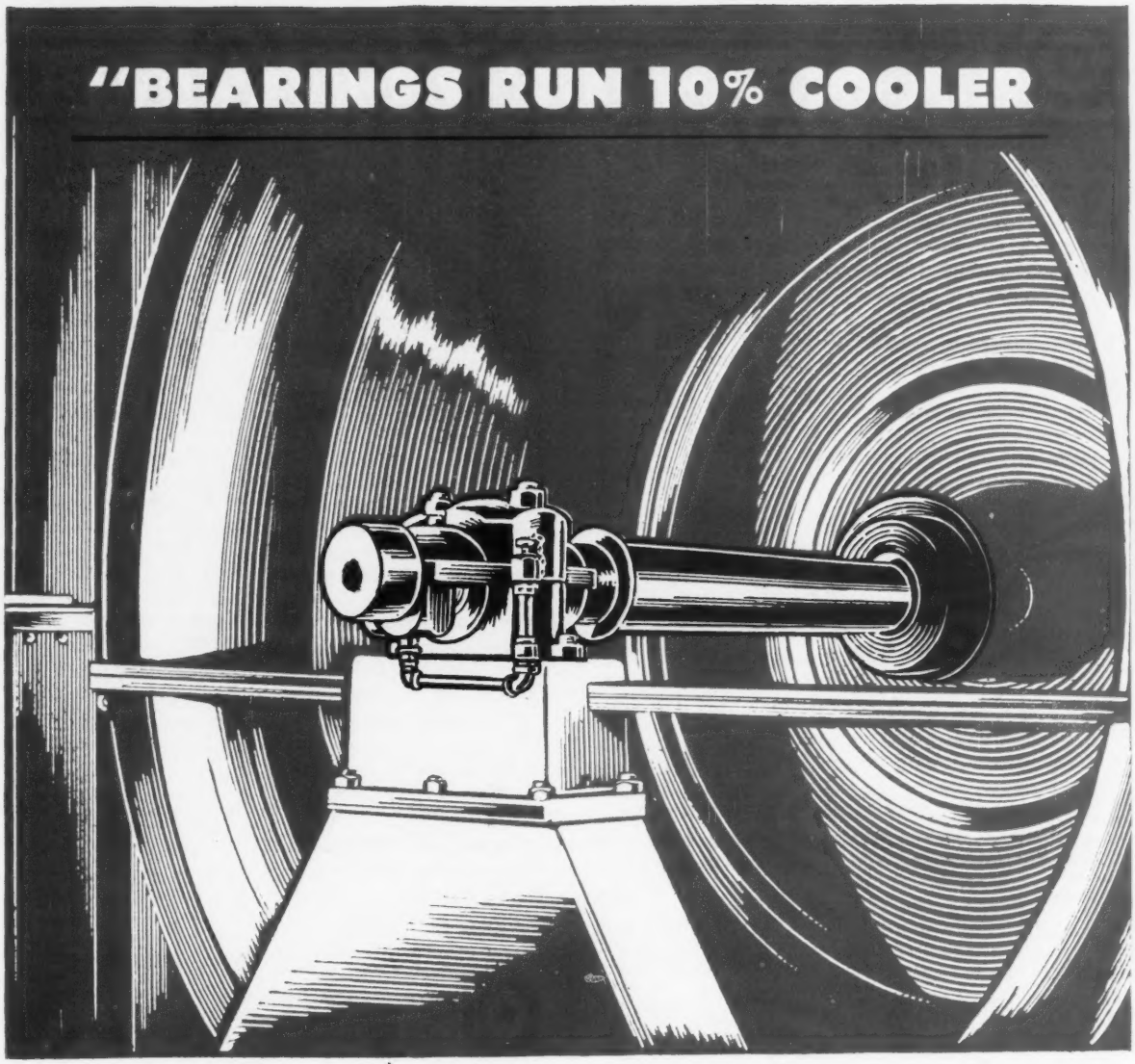

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A.S.L.E. SECTION ACTIVITIES

Pittsburgh Section

The Pittsburgh Section has held its customary monthly meetings which are reported in detail by Mr. George H. Davis, the retiring Secretary, with the good work being continued by Mr. J. I. C. Taylor who took over the position of Secretary at the December meeting.

The meeting of November 15th was held at the Penn McKee Hotel at McKeesport, Pennsylvania, with 37 at the dinner and several more after the dinner to attend the meeting.

Mr. Sumner reported for the Convention Committee that considerable progress has been made towards organizing the National Convention to be held in Pittsburgh next March. It was moved, seconded, and passed to raise the local dues to $3.00 for 1947 to cover additional expenses due to the convention.

Mr. Svenson appointed Messrs. States, Mandy, and Ross to act as a Nominating Committee for next year's officers of the Pittsburgh local section.

Dr. Mahncke then introduced Mr. G. L. Sumner of the Westinghouse Electric Corporation who gave a very interesting and informative paper on the "Evaluation of Greases." A lively discussion followed his paper which was very well received. The meeting then adjourned.

The regular December meeting and annual election of the Section was held at the Webster Hall Hotel on December 13th. Forty-one attended the dinner and several members dropped in later in the evening.

Mr. Svenson reported on the progress being made by the Convention Committee. Mr. White, chairman of the Entertainment Committee, reported on the increased cost of meals and several suggestions were made as to holding the meeting without the dinners or holding dinner meetings at some place outside of Pittsburgh where the prices have not gone up so much. It was decided to leave this matter to the new Entertainment Committee.

The Nominating Committee made their report and the annual election was held with the following officers being elected:

Chairman, Mr. J. D. Lykins; *Vice Chairman*, Mr. C. B. Kimpel; *Secretary-Treasurer*, Mr. J. I. C. Taylor; *Membership Committee*, Mr. G. L. Sumner; *Entertainment Committee*, Mr. E. B. Svenson, Jr.

It was decided to elect all three men nominated for the Program Committee with the man receiving the highest votes being appointed secretary so that the Program Committee for next year consists of:

Chairman, Mr. W. H. Mandy; *Members*, Mr. John Boyd; Mr. C. S. Bullions.

After the business session, Mr. J. R. Hewitt brought out his movie projector and screen and very enjoyably entertained the group with movies he had made of some of his various hunting trips.

The meeting then broke up into an informal social

A.S.L.E. Section Officers and Meeting Dates

BUFFALO:
Chair., Mr. W. G. Peuchen, Hershey Corp., Buffalo, New York.
Co. Chair., Mr. J. M. Courtright, Shell Oil Co. of Canada, Toronto, Ontario.
Secy.-Treas., Mr. J. E. Farry, Alemite Co., Buffalo, New York.
Next Meeting: **APRIL 10**

CHICAGO:
Chair., Mr. W. F. Leonard, 4541 Sheridan Rd., Chicago, Illinois.
V. Chair., Mr. D. N. Evans, Inland Steel Co., East Chicago, Indiana.
Secy.-Treas., Mr. S. A. Hastings, Crane Packing Co., 4418 N. Clark St., Chicago, Illinois.
Next Meeting: **MARCH 27, APRIL 24, MAY 22**

CLEVELAND-YOUNGSTOWN:
Chair., Mr. R. J. Hagan, Republic Steel Corp., Youngstown, Ohio.
V. Chair., Mr. L. H. Stranahan, White Motor Co., Cleveland, Ohio.
Secy., Mr. L. W. Fitch, Dingle-Clark Co., Cleveland, Ohio.
Treas., Mr. J. L. Finkelmann, Warren Refining and Chemical Co., Cleveland, Ohio.
Next Meeting: **MARCH 25, APRIL 22, MAY 27**

DETROIT:
Chair., Mr. W. A. Marshall, Alemite Co., 15501 Woodrow Wilson Ave., Detroit 3, Mich.
V. Chair., Mr. P. W. Uhl, Detroit Diesel Engine Div., 13400 W. Outer Dr., Detroit 13, Mich.
Secy., Mr. R. W. Kenyon, 2010 Mayburn St., Dearborn, Mich.
Treas., Mr. R. O. Holmes, 1403 Liberty Ave., Lincoln Park25, Mich.
Next Meetings: **To be Announced**

LOS ANGELES:
Chair., Mr. D. H. Moreton, Douglas Aircraft Corp., 3000 Ocean Park Blvd., Santa Monica, California.
V. Chair., L. G. Kline, Dow Chemical Co., Los Angeles, California.
Secy.-Treas., P. Kyropoulos, California Institute of Technology, Pasadena, California.
Next Meetings: **MARCH 4, APRIL 8**

MILWAUKEE:
Chair., Mr. Oscar Frohman, Ampco Metal, Inc., 4478 N. Cramer St., Milwaukee 11, Wisconsin.
V. Chair., Mr. G. Radosevitch, Harnischfeger Corp., 1622 S. 13th St., Milwaukee 4, Wisc.
Secy., Mr. R. Ley, Shell Oil Co., 3240 S. Burrell St., Milwaukee 7, Wisc.
Treas., Mr. C. Beck, Globe Steel Tubes, 2958 N. 21st St., Milwaukee, Wisc.
Next Meetings: **MARCH 24, APRIL 21**

NEW YORK:
Chair., Mr. D. D. Fuller, Dept. of Mech. Eng., Columbia Univ., New York 27, N. Y.
V. Chair., Mr. Henry Lee Norris, 600 W. 116th St., New York 27, N. Y.
Secy.-Treas., Mr. A. J. Zino, 27 Shoreview Rd., Manhasset, N. Y.
Next Meetings: **MARCH 27, MAY 15**

PHILADELPHIA:
Chair., Dr. Edgar S. Ross, Sun Oil Co., 1608 Walnut St., Philadelphia 3, Pa.
V. Chair., Mr. William P. Kuebler, Westinghouse Electric Corp., Philadelphia, Pa.
Secy.-Treas., Mr. J. H. Richards, Apex Alkali Prod. Co., Main & Rector Sts., Philadelphia 27, Pa.
Next Meetings: **MARCH 4**

PITTSBURGH:
Chair., Mr. J. D. Lykins, Wheeling Steel Corp., Yorkville, Ohio.
V. Chair., Mr. C. B. Kimpel, Carnegie, Illinois Steel Corp., Duquesne, Pa.
Secy.-Treas., Mr. J. I. C. Taylor, Sun Oil Co., Grant Building, Pittsburgh, Pa.
Next Meetings: **APRIL 18, MAY 16**

meeting with refreshments being served and a good time was had by all.

The January meeting of the Chapter was held at the Penn McKee Hotel in McKeesport, Pennsylvania. Chairman J. D. Lykins opened the meeting at 7:00 P. M., and after the minutes were read, Dr. E. M. Kipp was called on to report on plans for the National Convention which is described elsewhere in this issue.

Chairman Lykins read a letter from Dr. Mahncke outlining the program on lubrication being conducted by the Milwaukee Chapter. After an open discussion, Chairman Lykins appointed E. B. Svenson, Sr., W. Mandy, H. E. Ennis, and M. A. Stillwagon to investigate through the Pittsburgh area and report in the spring of any plan or lectures which might be of interest that could be started in the Fall.

Mr. Mandy reported for the Program Committee, saying a sound film would be presented at the February meeting entitled "Making and Shaping of Steel."

Mr. Cy Ackerman reported for the Entertainment Committee stating the meeting would be held at the Penn McKee Hotel with a dinner charge of $2.00.

Chairman Lykins then turned the meeting over to W. H. Mandy who introduced J. H. Russ of the Carbon and Carbide Chemical Company who gave a most interesting talk on Synthetic Oils, namely the "Yukon Oils."

Dr. MacGregor then introduced Mr. Peterson of the Dow-Corning Company who gave a very informative talk on Silicone Oils.

Cleveland-Youngstown Section

The Cleveland-Youngstown Section held its January meeting at the Cleveland Engineering Society where fifty-one members and guests had dinner.

Following the dinner the group proceeded to Socony Vacuum's Laboratory where four more members joined the group. The group of 55, was divided into parties of six or seven for the purpose of running tests on oils and greases. Various tests were made, including penetrations on greases, emulsion numbers on oils and viscosities of oils. The men were given every opportunity not only to ask questions, but to do the actual laboratory work.

The entire laboratory program was under the direction of Mr. J. Z. Valentine, Chief Chemist of the Socony Vacuum Oil Company. Everyone agreed that it was a most interesting meeting.

Milwaukee Section

The Milwaukee Section has taken the lead in setting up a Training Program on Industrial Lubricants and Lubrication. This program is open to all members of the Society and interested guests and consists of a series of lectures and discussion periods running on successive Monday evenings.

The program started January 6th and will end March 17th. The meetings are being held at the Engineers' Society Building.

Reports on the first few meetings have indicated an enthusiastic reception to the program, and progress is being watched with great interest by the other Sections.

Mr. Oscar Frohman, Chairman of the Section and Mr. Ralph M. Ley, Secretary of the Section, have been spending a large amount of their time in organizing and holding the program up to high standards.

The regular January meeting of the Section was held on the 20th. At this meeting Mr. J. P. Thomas, Special Lubrication Engineer of the Shell Oil Company, gave an extremely interesting paper on "Diesel Engine Lubrication."

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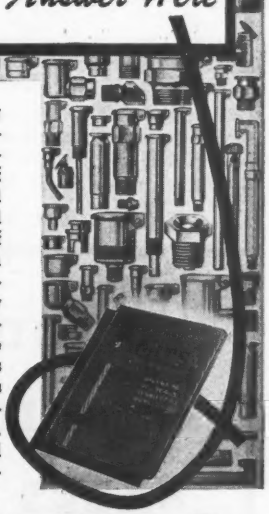

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Chicago Section

The Chicago Section held its November meeting on the 22nd at the Armed Forces Officer's Club in Chicago.

After dinner, the meeting was called to order by Chairman W. F. Leonard and the appointment of a Nominating Committee to choose possible candidates for Section Officers for the coming year was made as follows:

S. A. Hastings, *Crane Packing Company;* J. Sipchen, *John Sipchen Company;* B. Holmberg, *Socony Vacuum Company;* L. Burt, *Lincoln Engineering Company;* J. Ehret, *Ehret and Kinsey Company;* D. Evans, *Inland Steel Company.*

Elections for the Section will take place in May, 1947.

It was announced that Mr. H. D. Krummell, because of the great press of business activities, requested to be allowed to relinquish the office of Secretary and Treasurer and, in his place, Mr. S. A. Hastings was appointed to fill the unexpired term.

An interesting paper was read by Mr. C. A. Bailey of Carnegie Illinois Steel Company, the subject being "The Organization of a Lubrication Department." Mr. Bailey, from his long experience in the lubrication field, gave some sound ideas not only on the organization, but the need for such a department in industry.

There was a short intermission during which Mr. Corum entertained the members and guests with his famous cigarette tricks.

Mr. Charles Goldberg, President of the Chicago Mechanical Engineering Company, was then introduced. Mr. Goldberg's paper on "The Use of Lubricating Oil as a Hydraulic Media" proved to be of great interest, with many questions being asked Mr. Goldberg at the close of the meeting.

The meeting adjourned at 10:00 P. M., after an announcement by the Chairman of the National Committee that the next National Convention will be held in Pittsburgh, Pennsylvania, on March 17, 18, and 19, 1947.

The January meeting was held Thursday, January 23rd, at the Midland Hotel. Mr. S. A. Hastings reported that a Buffet Dinner was enjoyed by all, following which Mr. H. R. McGillivray of the Bowser Pump Company gave an interesting talk on "The Storage, Handling and Dispensing of Lubricants."

Following the meeting, Mr. B. H. Jennings, National Secretary-Treasurer, made some announcements about the March Convention, following which the Section had a business meeting. This was mainly concerned with the possibility of setting up an Educational Instructional Program in the Chicago Section resembling in some respects, that used in the Milwaukee Section. The result of this discussion is given in the following paragraphs which are quoted from the announcement that was sent to all of the members of the Section:

"For the benefit of the members of the A.S.L.E. who were not present at the regular meeting of the Chicago Section last Thursday evening, January 23rd, we wish to confirm a unanimous informal vote in favor of an Educational Program.

"To this end a committee was appointed under the Chairmanship of Mr. J. J. Slomer, to take action on the arrangements necessary for a series of weekly lectures on Lubricants and their proper application. These lectures are to be made available to the men in Industrial Plants in this area who will be invited, through their management, to attend. Proper auditorium facilities will be provided to insure a satisfactory seating capacity.

Your Society is entering its third year of activity and has enjoyed a remarkable growth, and we feel that the time is ripe to expand not only the Section but its outside activities. The successful consummation of this lecture program will be of benefit to the entire membership.

We need the co-operation of every member, and if you have any suggestions or desire additional information as to details, please contact Education Chairman J. J. Slomer."

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OIL CITY, PENNA.

National Lubricating Grease Institute Announces Convention

The Executive Committee of the National Lubricating Grease Institute meeting in Chicago designated Chicago, Illinois, as the place for the Fifteenth Annual N.L.G.I. Convention, October 16, 17, and 18th, 1947, as the date and the Edgewater Beach Hotel in the 5300 block on Sheridan Road as the convention headquarters. In making this decision the Executive Committee was guided by the ballots of the Board of Directors which had come in by mail expressing the Directors' wishes concerning the date and place of the next Annual N.L.G.I. Convention.

Clarence C. Wiedling

Funeral services for Clarence C. Wiedling, Chief Engineer and Technical Manager with Socony-Vacuum Oil Company, were held in Chicago, Illinois, February 8, 1947. Mr. Wiedling, 54, passed away at his home in Chicago, February 5, after an illness of several months.

Mr. Wiedling joined Socony-Vacuum in 1919 and was promoted steadily to his present postion. He was formerly associated with International Harvester Company; Public Service Co. of Northern Illinois, and Commonwealth Edison Company.

He was for many years Chief Engineer of the Industrial Department, Chicago Division of the Socony-Vacuum Oil Company, and in that capacity has been identified with many developments in lubrication and lubrication practices.

He participated actively in A.S.L.E. affairs, in the Chicago Section, particularly during the period when the Section was being organized and he has since served on several committees.

Mr. Wiedling leaves his son, Charles, and two daughters, Edith and Dorothy Wiedling.

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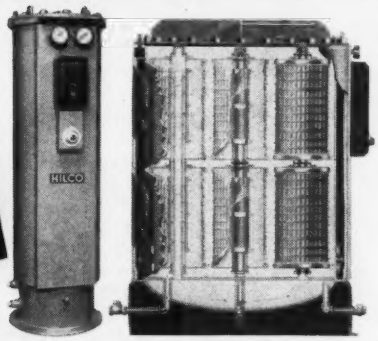

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**Both are interchangeable at any time.*

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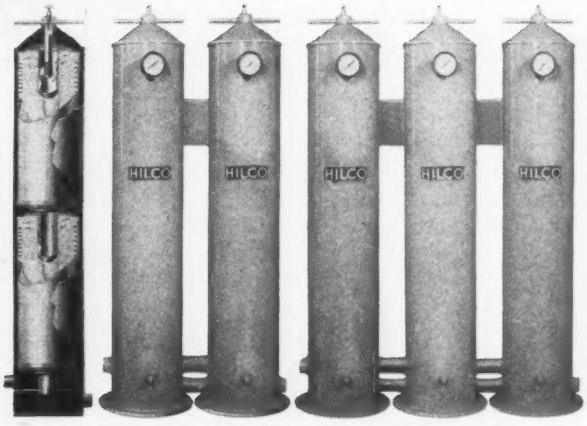
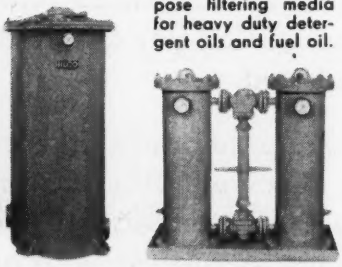


- Hilco Hyflow Oil Filters use Hilite-Fuller's Earth for filtering straight mineral and fuel oil or Hiltex-Cellulose, the all-purpose filtering media for heavy duty detergent oils and fuel oil.

HILCO HYFLOW OIL FILTERS "C" SERIES



- For Lube and Bulk Fuel using one or a multiple of 7¼" x 18" Filter cartridges offering the maximum in filter area and correct depth for high flow rates and efficient filtration. Available in simplex type with or without heaters, duplex without heaters.

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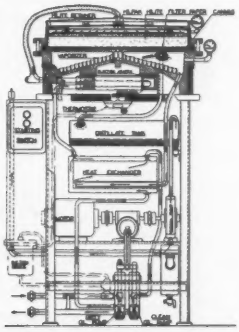

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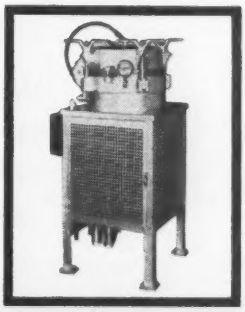
Hilite-Fuller's Earth for filtering straight mineral oils—ADSTAY DISCS for heavy duty detergent oils.



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Unsolicited reports from Diesel operators throughout the country reveal operating economies of "Clean Oil" made possible by **Honan-Crane Purifiers.**

LET'S TAKE A LOOK AT SOME OF THESE REPORTS . . .

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"operated Caterpillar D17000 engine 13,000 continuous hours without a change of oil or shut down for repairs."

WISCONSIN
"save $137.00 per month on lube oil used in 875 H.P. Worthington Diesels."

NEW JERSEY
"Replaced filters with **Honan-Crane Oil Purifiers** and extended periods between shutdowns for inspection and overhauls by 100% on two Chicago Pneumatic and one Buda."

IOWA
"2,655 KWH per gallon of lube oil and $0.000099 maintenance costs per KWH on Nordberg Diesels."

OHIO
"cut lube oil consumption on 17 Diesel engines by 50%."

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"save $500.00 monthly in operating expenses on two 1,000 H.P. Diesels."

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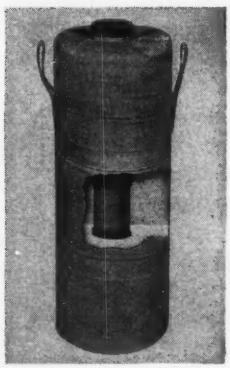
"oil in service 5,500 hours in De La Vergne Diesel, recommended by oil company for additional 2,500 hours before another check."

The New Type "M" Honan-Crane Oil Purifier with Interchangeable Fuller's Earth or Cellulose Filter Cartridge



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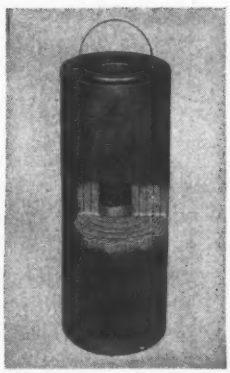

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Membership in the Society is in several grades as defined below. Assignment to grade is made by the Admissions Committee or Board of Directors on the basis of information submitted or supplied by references.

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Members shall be: (1) persons not less than twenty-four years in age who are engaged in research and instruction at technical schools, universities and various publicly and privately supported institutions in the field of lubrication; or (2) persons not less than twenty-four years in age who have occupied recognized positions as Lubrication Engineers for a period of three or more (not necessarily consecutive) years prior to date of admission, involving the responsibility for or supervision of the development, selection, field use and application of lubricants as differentiated from other activities; or (3) persons not less than twenty-four years in age who are indirectly concerned with the field of lubrication, but possessing other qualifications of experience, knowledge and accomplishment, have manifested a particular interest in the purposes and welfare of the Society, to the extent that their membership would be a valuable contribution to the successful functioning of its activities.

$10.00

JUNIOR MEMBERS

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